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ABSTRACT

This document is designed to provide practical information for teaching the Chemistry 20-30 Program of Studies. The first section provides an overview of Chemistry 20, explaining the program philosophy and the relationships among science, technology, and society. The use of concept connections and teaching a course around major science themes is described, as well as how the program articulates with the junior and senior high science courses. Section two contains four units. In unit one, students investigate a variety of solutions, learn of the characteristics of acids and bases, how to express concentration, and methods of preparing and handling solutions. In unit two, students are required to use mathematical manipulation and stoichiometric principles to predict quantities of substances consumed or produced in chemical reactions. In unit three, students are helped to relate theories about bonding to the properties of compounds and to develop explanations and descriptions of structure and bonding through scientific models. In unit four, students are introduced to the characteristics of organic compounds, the general nomenclature and formulas for hydrocarbon categories, their reactions and significant derivatives. The final section provides detailed information on a great variety of resources that support the implementation of this program. (ZWH)

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CHEMISTRY 20–30

BACKGROUND, EXEMPLARS AND RESOURCES

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CHEMISTRY 20–30

BACKGROUND, EXEMPLARS AND RESOURCES

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Writers

Desiree Hackman	Curriculum Standards Branch, Alberta Education
Pamela Shipstone	Alberta Distance Learning Centre, Alberta Education
Stella Shrum	Program Consultant, Chemistry, Curriculum Standards Branch, Alberta Education

Alberta Education, Curriculum Standards Branch

Desktop Publishing:	Shelley Gauthier Lin Gray Dianne Hohnstein Esther Yong
Administration:	Lloyd Symyrozum, Director Merv Thornton, Assistant Director Raja Panwar, Program Manager, Secondary Science Bev Romanyshyn, Project Coordinator

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PREFACE

Chemistry 20–30 Background, Exemplars and Resources, 1994 is designed to provide practical information for teaching the Chemistry 20–30 Program of Studies, which outlines what students are required to learn.

BACKGROUND

This section provides an overview of Chemistry 20, explaining the program philosophy and the relationships among science, technology and society that are explored through unit objectives. The use of concept connections and teaching a course around major science themes is described, as well as how the program articulates with the junior and senior high science courses.

EXEMPLARS

Exemplars are lesson outlines that closely follow the learning cycle set out in the specific learner expectations section of the Chemistry 20–30 Program of Studies. They provide models of how Chemistry 20 classroom activities can be structured to effectively accomplish the program objectives and include suggestions for assessment and evaluation of such activities. The strategies can be easily generalized to the Chemistry 30 situation.

RESOURCES

The resource lists in this section provide detailed information on a great variety of resources that support the implementation of this program. These resources include authorized teaching background resources, basic student learning resources, support learning resources for students and many other resources not authorized but deemed useful for specific parts of the Chemistry 20–30 program. As far as possible resources are keyed to specific units of study. Detailed annotations, distributor information and approximate prices for each resource listed are provided.

A senior high science teacher will find it useful to have both the *Senior High Science Teacher Resource Manual,* 1992 (Interim) and the *Chemistry 20–30 Background, Exemplars and Resources,* 1994. The two are designed to work together, avoiding repetition of material common to all science programs.

The following documents support the senior high science curricula:

Science 16 Teacher Resource Manual, 1990 (Interim)
Science 26 Teacher Resource Manual, 1991 (Interim)
Science 14–24 Teacher Resource Manual, 1989
Senior High Science Teacher Resource Manual, 1992 (Interim)
Science 10 Teacher Resource Manual, 1992 (Interim)
Biology 20–30 Background, Exemplars and Resources, 1994
Chemistry 20–30 Background, Exemplars and Resources, 1994
Physics 20–30 Background, Exemplars and Resources, 1994
Science 20–30 Background, Exemplars and Resources, 1994

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BACKGROUND

BACKGROUND TO THE CHEMISTRY 20 PROGRAM

by Stella Shrum

Chemical knowledge advances within a social context; and although science is a powerful tool, it also has limitations.

Chemistry is the study of the composition, properties and interactions of matter. Chemical knowledge advances within a social context, and it is important for students to realize that the principles and laws they accept as fact are the result of extensive observations and analysis done by scientists; and that although science is a powerful tool, it also has limitations. While the products of chemistry allow us to live better and longer lives, there is often a related cost. Many of the science-related issues we face today have a basis in chemistry. As students are required to make decisions about societal issues related to chemistry and chemical technology, knowledge will help them to make informed choices.

The Chemistry 20 program builds on the fundamental attitudes, skills and knowledge acquired in Science 10 and provides students with the foundation they need for Chemistry 30. Chemistry 20 consists of four units of study.

The relationships among science, technology and society are explored through issues related to the environmental effects of certain solutions.

In Unit 1, students investigate a variety of solutions, learn of the characteristics of acids and bases, how to express concentration, and methods of preparing and handling solutions. They also investigate the quantitative relationships among the temperature, pressure and volume of gases. The nature of science is exemplified by the role of evidence and the usefulness of models and theories in the quest to know more about matter and its changes. The science and technology context is illustrated by the applications of solutions, acids and bases in industry and in the application of measuring instruments. The relationships among science, technology and society are explored through issues related to the environmental effects of certain solutions and by examples of the prevalence, in everyday life, of solutions including acids, bases and gases.

The relationship among science, technology and society is illustrated through examples of reactions taken from industrial applications of chemistry.

In Unit 2, students are required to use mathematical manipulation and stoichiometric principles to predict quantities of substances consumed or produced in chemical reactions. Students must call on their learnings from Unit 1 to determine quantities of species in solution and substances in gaseous form. The nature of science is exemplified by demonstrating the relationship between experimental observations and scientific principles and the need for careful measurements and precise calculations in obtaining accurate results. The relationship among science, technology and society is illustrated through examples of reactions taken from industrial applications of chemistry.

In Unit 3, students are helped to relate theories about bonding to the properties of compounds and to develop explanations and descriptions of structure and bonding through scientific models. This use of scientific models and theories to explain the properties of matter exemplifies the nature of science. The science, technology and society connections are illustrated through applications of bonding theory.

This use of scientific models and theories to explain the properties of matter exemplifies the nature of science.

In Unit 4, students are introduced to the characteristics of organic compounds, the general nomenclature and formulas for hydrocarbon categories, their reactions and significant derivatives. In using models to illustrate the diversity and complexity of organic compounds students learn more about the nature of science. The science, technology and society connections are addressed by examining the impact of organic compounds on our lives and on the environment.

In using models to illustrate the diversity and complexity of organic compounds, students learn more about the nature of science.

PROGRAM ARTICULATION

Theme	Junior High	Science 10	Chemistry 20
Change	Chemical and physical change Rates of chemical reactions	Chemical, physical and nuclear changes Conservation in chemical change	Quantitative relationships in chemical change Chemical change brought about by humans Chemical change and the environment
Diversity	Properties of matter: • structure • melting point • density • solubility • reactivity	Energy and matter exist in many forms	Matter in a variety of forms Bonding in matter as a continuum
Energy	Heat from chemical change	Energy exists in many forms Potential and kinetic energy Law of conservation of energy Energy transformation	Chemical potential energy Fossil fuels
Equilibrium	Solubility Rate of dissolution Chemical and physical prevention of corrosion	Geochemical cycles	Dynamic equilibrium between dissolving and crystallization, evaporation and condensation
Matter	Composition, concentration, chemical and physical properties of matter Acids and pH	Matter has mass and occupies space Periodic table classifies elements Atomic structure Atoms, ions, molecules, isotopes and radio isotopes Acids and bases	Ionic and molecular compounds Acids and bases States of matter
Systems		Energy systems (input/output)	Quantitative relationships in a chemical system

EXEMPLARS

THE BEHAVIOUR OF GASES

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Chemistry 20 course of studies.

Program **General Learner Expectations**

The **themes** emphasized are *change, matter* and *systems.*

The aspects of the **skills framework** emphasized are:

Initiating and Planning

- identifying all variables and controls
- identifying materials and apparatus required
- formulating questions, hypotheses and/or predictions to guide research

Collecting and Recording

- organizing and correctly using apparatus and materials to collect reliable experimental data
- accurately observing, gathering and recording data or information according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations

Organizing and Communicating

- organizing and presenting data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
- communicating data more effectively, using mathematical and statistical calculations, where necessary

Analyzing

- analyzing data or information for trends, patterns, relationships, reliability and accuracy
- identifying and discussing sources of error and their affect on results

Connecting, Synthesizing and Integrating

- summarizing and communicating findings

Evaluating the Process or Outcomes

- considering consequences and perspectives
- identifying limitations of the data or information and interpretations or conclusions, as a result of the experimental/research/project/design process or method used
- suggesting alternatives and considering improvements to experimental technique and design
- evaluating and assessing ideas, information and alternatives

The **STS connections** emphasized are:

- the functioning of products or processes based on scientific principles

Course General Learner Expectations

Knowledge

- describe solution systems, including acids, bases and gases, quantitatively and qualitatively, and relate their properties to their uses
- describe the diverse forms of matter, using models to illustrate bonding and structure, and theories to explain the properties and behaviour of a variety of elements and organic and inorganic compounds and solutions, including acids, bases and gases

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts
- interpret and analyze data that yield straight- and curved-line graphs; and use appropriate SI notation, fundamental and derived units, and formulas; and derive from graphs mathematical relationships among variables

STS Connections

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which chemistry and technology advance one another, using appropriate and relevant examples

Major Concept 3

A model of the gaseous state of matter provides insight into molecular behaviour.

Specific Learner Expectations

Knowledge

- relating Boyle's, Charles's and Avogadro's laws to the ideal gas law
- describing the behaviour of ideal and real gases in terms of the kinetic molecular theory
- performing calculations based on the ideal gas equation, $PV = nRT$, under a variety of conditions; e.g., STP, SATP

Skills

- drawing and interpreting graphs of experimental data that relate pressure and temperature to gas volume
- designing and performing an experiment to illustrate the gas laws, identifying and controlling variables
- performing and evaluating an experiment to determine molar mass from gaseous volume
- using empirical data to do calculations based on the ideal gas law

STS Connections

- providing examples of products and processes from daily life that illustrate the application of the properties of gases; e.g., breathing, olfaction, weather, scuba diving, ammonia fertilizer, internal combustion engine, steam turbine, hot air balloon, automobile air bag

OR

- describing, from a historical perspective, the central role of experimentation, and the development of technologies capable of precise measurement in the formulation of the gas laws

OR

- evaluating, in terms of the influence of the needs, interests and financial support of society on scientific and technological research, the advantages and disadvantages of using compressed gases as fuels; e.g., hydrogen, methane, propane

Introduction

Provide instances from everyday life that illustrate the properties of gases, asking questions like the following, as the focus for class discussions or library investigations for oral presentation to the class.

- How does human breathing occur?
- How do we detect odours?
- What causes a chinook?
- What is in a scuba diving tank?
- What causes the bends? What is a decompression chamber?
- What causes the pistons to rise in the cylinders of the internal combustion engine?
- How does a steam turbine work in the production of electricity?
- What causes a hot air balloon to rise?
- Why do most balloonists go up early or late in the day?
- How does an automobile air bag work?

Experiential Exploration

Have students perform an activity to show the relationship between gas volume and pressure, and gas volume and temperature. Have students develop an hypothesis first, then design an experiment and analyze the data graphically.

Hypothesis-building

Use a class discussion format to evaluate the experimental procedures and findings, relating the behaviour of gases to the kinetic molecular theory of matter.

Elaboration

Have students do practice problems relating gas volume, temperature and pressure. Develop the concept of molar volume from a description of the experimental work of Avogadro. Relate the gas laws and molar volume by deriving the formula, $PV = nRT$, and have students practise problems based on it. Have students perform an experiment to determine molar mass from gaseous volume.

Application

Have students research how Robert Boyle investigated the relationship between gas volume and pressure, using a simple J-tube apparatus; and the kind of experiments carried out by Jacques Charles on the relationship between gas volume and temperature. Ask students to explain what would happen if a diver rose very quickly from a depth underwater where the pressure was double the atmospheric pressure (about 10 metres). Have students research the cause of nitrogen narcosis, and relate this to the composition of gases contained in scuba diving tanks.

Significance

Have a classroom debate on the topic: "Hydrogen (or methane) gas should be the major fuel in our economy, replacing petroleum-derived fuels."

Information Source

"Energy for Motor Vehicles," Bleviss, D. L. and P. Walzer. *Scientific American*, Vol. 263, September 1990.

Evaluation

Correct gas law problems together in class. Tests and quizzes should also focus on gas law problems. Have students hand in reports of their experiments. Use a fishbowl format for the hydrogen debate—half the students debate, and the other half assess their presentation.

STOICHIOMETRY

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Chemistry 20 course of studies.

Program General Learner Expectations

The **themes** emphasized are *change* and *systems*.

The aspects of the **skills framework** emphasized are:

Initiating and Planning

- identifying materials and apparatus required

Collecting and Recording

- carrying out the procedure and modifying, if necessary
- organizing and correctly using apparatus and materials to collect reliable experimental data
- accurately observing, gathering and recording data or information according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations

Organizing and Communicating

- expressing measured and calculated quantities to the appropriate number of significant digits, using SI notation for all quantities
- communicating findings of investigations in a clearly written report

Analyzing

- identifying and discussing sources of error and their affect on results

Connecting, Synthesizing and Integrating

- predicting from data or information
- relating the data or information to laws, principles, models or theories identified in background information

Evaluating the Process or Outcomes

- suggesting alternatives and considering improvements to experimental technique and design

The **STS connections** emphasized are:

- the central role of experimental evidence in the accumulation of knowledge, and the way in which proposed theories may be supported, modified or refuted
- the functioning of products or processes based on scientific principles
- the use of technology to solve practical problems

Course General Learner Expectations

Knowledge

- explain chemical changes to matter; and write balanced chemical equations to describe transformations and analyze them, quantitatively and qualitatively, to make predictions about the products formed or reactants consumed; and apply this knowledge to stoichiometric calculations in a variety of everyday and industrial situations

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts
- use mathematical language of ratio and proportion, numerical and algebraic methods, gravimetric and solution stoichiometry and unit analysis to solve single- and multi-step problems; and communicate scientific relationships and concepts

STS Connections

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which chemistry and technology advance one another, using appropriate and relevant examples
- identify subject-related careers and apply the skills and knowledge acquired in Chemistry 20 to everyday life and to related and new concepts in subsequent studies of chemistry

Major Concept 1

Balanced chemical equations indicate the quantitative relationships among reactants and products involved in chemical changes.

Specific Learner Expectations

Knowledge

- analyzing chemical equations in terms of atoms, molecules, ionic species and moles
- using gravimetric, solution and gas stoichiometry to predict quantities of products/reactants involved in chemical reactions
- using estimation and unit analysis in stoichiometric calculations
- explaining stoichiometric calculations using chemical principles

Skills

- performing experiments to test the validity of assumptions contained in stoichiometry methods, by, for example, predicting reaction results, then measuring the amount of product obtained from a reaction, and calculating the per cent yield

STS Connections

- analyzing, using stoichiometric and chemical principals, the chemical reactions involved in various industrial and commercial products and processes; e.g., fertilizers, production of sodium and chlorine in the Down's Cell, Haber–Bosch production of ammonia, combustion of fuels, water treatment, inflation of automobile air bags

OR

- discussing the central role of experimental evidence and the way in which scientific theories may be supported, modified or refuted, by, for example, citing Lavoisier's role in disputing the caloric theory

Introduction

Investigate how fertilizers are made.

Information Source

Sherritt-Gordon Mines Ltd., Fort Saskatchewan, Alberta. Esso Chemical Canada Inc., Box 28000, Edmonton, Alberta, T5J 4R4 (request their brochure on the agricultural chemicals complex).

Penner et al. *Visions 2.* Toronto, ON: Gage Educational Publishing Company, 1993 (pages 274–283).

Smith et al. *Alchem Chemistry: Science, Technology, Society.* Edmonton, AB: J. M. Le Bel Enterprises Ltd., 1990 (pages 642–649).

Experiential Exploration

Visit a fertilizer plant. Make a flow chart of the process for making fertilizers. Explore the meaning of the numbers on the side of a fertilizer bag—they refer to the per cent of N, P and K content.

Calculate the per cent of nitrogen available in various kinds of fertilizers; e.g., ammonia, ammonium nitrate, ammonium sulfate, urea $(NH_2)_2CO_{(s)}$.

Make ammonium sulfate fertilizer by reacting aqueous ammonia with sulfuric acid—reaction endpoint can be determined with an indicator. The water can be evaporated from the crystals and the resulting fertilizer used to fertilize a plant in a comparison study.

Hypothesis-building

Use a class discussion to focus on the importance of chemical changes to industrial processes, such as the production of fertilizers and how quantitative analysis of chemical reactions is essential in determining and maximizing yield and reducing waste. Analyze a chemical equation to show how molar ratios can be used to predict quantities of reactants and products.

Elaboration

Direct students to use molar ratios to predict the quantity of ammonium sulfate that could be produced by the procedure used in Experiential Exploration, then compare this to the actual yield, and evaluate the experimental design. Explain what is meant by limiting species, predicted and experimental yields. Discuss the role of experimental evidence in supporting or changing scientific theories.

Extend the exercises on predicting from chemical equations to include a variety of industrial and everyday applications involving matter in any of the three states, under various conditions.

Application

Carry out an experiment with a reaction involving matter in the gaseous state; e.g., active metal with hydrochloric acid, and make stoichiometric predictions, using mole ratios and the gas laws. Compare the yield with the prediction and evaluate the experimental design. Have students research the phlogiston controversy.

Significance

Investigate careers in chemistry that require a knowledge of quantitative analysis, such as the fertilizer industry.

Evaluation

Quizzes, tests and assignments should focus on stoichiometric problems. Specific details of the fertilizer industry should not be evaluated. Have students hand in a written report of their experiments. Have students prepare oral reports on careers for presentation to their classmates, or prepare a bulletin board display of the information.

CHEMICAL BONDING IN MATTER

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Chemistry 20 course of studies.

Program General Learner Expectations

The **themes** emphasized are *change* and *matter*.

The aspects of the **skills framework** emphasized are:

Initiating and Planning

- assembling and recording background information
- designing and/or describing a plan for research, or to solve a problem

Analyzing

- identifying main ideas

Connecting, Synthesizing and Integrating

- predicting from data or information
- summarizing and communicating findings

Evaluating the Process or Outcomes

- evaluating and assessing ideas, information and alternatives

The **STS connections** emphasized are:

- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science
- the limitations of scientific knowledge and technology

Course General Learner Expectations

Knowledge

- describe the diverse forms of matter, using models to illustrate bonding and structure, and theories to explain the properties and behaviour of a variety of elements and organic and inorganic compounds and solutions, including acids, bases and gases

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts

STS Connections

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which chemistry and technology advance one another, using appropriate and relevant examples

Major Concept 1

Chemical bonding in matter results in the formation of compounds.

Specific Learner Expectations

Knowledge

- defining a chemical bond as resulting from the simultaneous attraction of electrons by two or more atomic nuclei
- describing bonding as a continuum ranging from complete electron transfer to equal sharing of electrons
- defining valence electron, electronegativity, electron pairing, ionic and covalent bond
- explaining why formulas for ionic compounds refer to the simplest whole number ratio of ions that results in a net charge of zero, while the formulas for molecular compounds refer to the number of atoms of each constituent element

Skills

- building models depicting the structure of simple covalent molecules and ionic solids
- using data contained in the periodic table, and the activity series to predict bonding and electron transfer between elements
- drawing electron dot diagrams of atoms and molecules, and using Lewis structures to predict bonding in simple molecules

STS Connections

- analyzing the functioning of everyday products and processes in which ionic and covalent compounds are significant, for example; investigating the composition of household products, combustion reactions and life processes

OR

- outlining the limitations of bonding theories, by, for example, investigating bonding in metals and ceramics, and investigating the concept of resonance

OR

- interrelating the applications and properties of modern materials, such as semiconductors, ceramics and composites, explaining how science and technology interact in the production and distribution of useful materials, and the influence of the needs, interests and financial support of society on scientific and technological research

Introduction

Place an array of common ionic and molecular compounds in front of the class and ask students how they would distinguish between the two categories on the basis of what they learned previously about their properties. Have students distinguish between the synthetic and natural compounds in the display and then do an inventory of the number of compounds they use on a daily basis to categorize them as ionic or molecular, synthetic or natural.

Based on the number of elements in the periodic table that can be used to make compounds (about 90), have students calculate the potential number of compounds that can be made from the following combinations:

- 2 elements in a one-to-one ratio
- 3 elements in a one-to-one ratio
- 2 elements in a two-to-one ratio
- other combinations of interest.

Experiential Exploration

Have students build models of simple covalent molecules and ionic solids, using common everyday materials, and based on their own investigations of structure, using textbooks and other resource materials.

Have students produce a gel by reacting 25 mL of ethanol with 5 mL of saturated calcium acetate solution.

Hypothesis-building

Review the various categories of matter and where given examples fit into the classification scheme.

Discuss the themes of diversity and unity as they apply to the formation of compounds from elements. State the basic tenets of the bonding theory, and discuss its limitations.

Elaboration

Discuss the use of compounds in everyday life; the significance of synthetics, their composition and the issue of disposal.

Analyze formulas for the type of compound they represent. Use the periodic table to predict bonding. Write the chemical formulas. Verify predictions, using a reference source, such as the *CRC Handbook of Chemistry and Physics*.

Draw electron dot diagrams of atoms and molecules, and use Lewis structures to predict bonding in molecules.

Application

Extend the discussion of matter to the bonding that occurs in solutions, gels, suspensions, emulsions, glues, etc.

Have students investigate the life of Linus Pauling, winner of the Nobel Prize for Chemistry (in 1954) for his work on chemical bonds.

Significance

Have students investigate the development of modern materials, such as semiconductors, ceramics and composites, and the impact they have had on our lives. Students may be particularly interested in the development of materials to repair the human body; e.g., artificial bone, synthetic skin, blood substitutes. Encourage students to speculate about future developments and where they might lead. Ask students what new compound of material they would develop and why.

Information Sources

Golob, Richard and Eric Brus (eds.). *The Almanac of Science and Technology*. Toronto, ON: HBJ-Holt of Canada Ltd., 1990.

Spindel, William and Robert M. Simon (eds.). *Frontiers in the Chemical Sciences*. Washington, DC: American Association for the Advancement of Science, 1986.

Magazines, such as *Popular Science* and *Discover*.

Evaluation

Test students on their ability to predict bonding, to write appropriate formulas for compounds, and to draw electron dot diagrams and Lewis structures.

Provide marks for student models of compounds.

Have students write a paragraph on the bonding theory and its limitations, as part of the long answer component of the unit test.

Have students hand in a paper of their investigations into modern materials, as outlined in the Significance section.

INVESTIGATING POLYMERS

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Chemistry 20 course of studies.

Program **General Learner Expectations**

The **themes** emphasized are *change, diversity, matter* and *systems*.

The aspects of the **skills framework** emphasized are:

Initiating and Planning

- designing and/or describing a plan for research, or to solve a problem

Collecting and Recording

- organizing and correctly using apparatus and materials to collect reliable experimental data
- accurately observing, gathering and recording data or information according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations

Organizing and Communicating

- communicating findings of investigations in a clearly written report

Connecting, Synthesizing and Integrating

- identifying further problems or issues to be investigated
- identifying alternatives for consideration
- proposing and explaining interpretations or conclusions

Evaluating the Process or Outcomes

- evaluating and assessing ideas, information and alternatives

The **STS connections** emphasized are:

- the functioning of products or processes based on scientific principles
- the limitations of scientific knowledge and technology
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations

Course General Learner Expectations

Knowledge

- describe the diverse forms of matter, using models to illustrate bonding and structure, and theories to explain the properties and behaviour of a variety of elements and organic and inorganic compounds and solutions, including acids, bases and gases

Skills

- collect, verify and organize data into tables of their own design, and graphs and diagrams of others' design, using written and symbolic forms; and describe findings or relationships, using scientific vocabulary, notation, theories and models

STS Connections

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which chemistry and technology advance one another, using appropriate and relevant examples
- explain for a given instance how science and technology are influenced and supported by society, and the responsibility of society, through chemistry and technology, to protect the environment and use natural resources wisely

Major Concept 2

The chemical changes of organic compounds are many and diverse.

Specific Learner Expectations

Knowledge

- defining and outlining the structures of, and providing examples of, monomers, polymers and polymerizations in living and non-living systems; e.g., plastics, carbohydrates, proteins

Skills

- building models depicting polymerization
- synthesizing an organic compound; e.g., ethylalcohol, an ester, a polymer or soap

STS Connections

- analyzing common polymers in terms of chemical composition and structure; e.g., paper, plastics, fibres, foods, found in the home, school and community

OR

- describing the petrochemical industry in Alberta and investigating career opportunities related to organic chemistry

OR

- assessing the positive and negative effects of synthetically produced organic compounds, recognizing that the development of these products has played a major role in our quality of life and standard of living but that a practical solution to related social and environmental problems often requires a compromise between competing priorities

Introduction

Prepare a display of natural and synthetic polymers.

Product	Polymer (natural)	Monomer (repeating units)
corn starch, laundry starch	starch	glucose, $C_6H_{12}O_6$
paper, wood, cotton	cellulose	glucose, $C_6H_{12}O_6$
lean meat, beans	protein	amino acids, $NH_2\overset{R}{\underset{|}{C}}HCOOH$
DNA, RNA (use models from biology laboratory)	nucleic acids	nucleotides (a sugar, a phosphate, a nitrogenous base)
latex gloves, surgical tubing. golf balls	natural rubber	isoprene, $CH_2=\overset{CH_3}{\underset{|}{C}}-CH=CH_2$ or 2–methylbutadiene
	Polymer (synthetic)	
plastic toys, containers; e.g., ice cream pails	polyethylene	ethene, $CH_2=CH_2$
styrofoam cups	polystyrene	styrene, $C_6H_5-CH=CH_2$ or vinyl benzene
plumbing pipe, credit cards	polyvinyl chloride (PVC)	vinyl chloride, $CH_2=CHCl$ or chloroethene
windbreaker jackets, nylon stockings	polyamide; e.g., nylon	diamine + dicarboxylic acid, $(C_2H_2)_4-\overset{O}{\overset{\|}{C}}-NH-(CH_2)_6$
thread, fabric, carpet	polyester; e.g., Dacron	ethylene glycol + dicarboxylic acid $\overset{O}{\overset{\|}{C}}-C_6H_5-O-C-O(CH_2)_2$ or 1, 2–dihydroxyethane
bearings, pan coatings	teflon	tetrafluoroethene, $CF_2=CF_2$

Experiential Exploration

Have students build models for some of the simpler monomers then come together as a group and try to join them into polymers. Models of chains made of paper clips or plastic beads can be used to demonstrate the length and the concept of cross linking between chains.

Depending on availability of materials, other activities that may be appropriate, are:

- a demonstration of making nylon
- making "slime" from polyvinyl alcohol and borax:
  - thoroughly dissolve (by heating) 3.0 g of polyvinyl alcohol in 100 L of water. Cool. Stir in vigorously; 100 mL of a 3% borax solution
- investigating the effect of acid rain on nylon stockings

Hypothesis-building

Discuss with students the differing properties of polymers and the relationship of properties to structure, for example:

Why are some polymers stretchy?—The chains form into loops somewhat like a telephone cord.
Why are some polymers hard and others flexible?—The hard ones have numerous cross links between the chains while the flexible ones do not.

Elaboration

Have students practise writing reactions for addition and condensation polymerization. Have students analyze given structural formulas for polymers to try to identify the repeating units (monomers).

Application

A discussion of the difference in biodegradability between natural and synthetic polymers can lead to the issue of plastics accumulating in the environment and some of the ways society has tried to address this, for example:

- incineration (Europe)
- recycling (Edmonton's Blue Box program)
- increasing the biodegradability (using starch as a filler in garbage bags, developing "natural" plastics produced by microorganisms)

Significance

Investigate the production of polyethylene in Alberta in terms of:

- source of ethane (extracted from natural gas at gas processing plants)
- ethane conversion to ethene (ethane is shipped in liquid form to conversion plants where it is further purified and converted into ethene, using a cracking process)
- polymerization of ethene (a process requiring heat, pressure and a catalyst is used to manufacture polyethylene)
- contribution to the economy (major export from Canada)

Information Sources

Jenkins et al. *Ethylene and Its Derivatives.* Edmonton, AB: J. M. Le Bel Enterprises, 1979.

For further information, write directly to the following companies:

Dow Chemical Canada Inc.
Western Canada Division
Bag 16
Fort Saskatchewan, Alberta
T8L 2P4

Novacor Chemicals Ltd.
and
Alberta Gas Ethylene Company Ltd.
P.O. Box 5006
Red Deer, Alberta
T5N 6A1

Union Carbide Ltd.
P.O. Box 5501
Red Deer, Alberta
T5N 6N1

AT Plastics Inc.
4405 – 101 Avenue
Edmonton, Alberta
T5J 2K1

Evaluation

Tests and quizzes should focus on student ability to recognize and define polymers, describe their properties, and to write reactions for simple polymerizations. Students should also be expected to know some general information about the production of ethylene and polyethylene in Alberta.

The activities should be evaluated as suited to the circumstances of the classroom.

As a follow-up to the discussion in the Hypothesis-building section, a short essay could be assigned on the topic of the accumulation of plastics in the environment, asking students to define the problem and propose some solutions.

Have students write letters to the companies involved in the ethylene industry inquiring about such things as products, processes and careers. Evaluate for clear communication, appropriate language, etc.

RESOURCES

RESOURCES OVERVIEW

by Desiree Hackman and Pamela Shipstone

The following is a list of resources useful for implementing the Chemistry 20–30 program. This resource list is divided into the following sections:

Chemistry 20 Major Concepts with Resource Listings (by Unit)
Chemistry 30 Major Concepts with Resource Listings (by Unit)
Chemistry 20–30 Basic Student Learning Resources
Chemistry 20–30 Authorized Student Support/Teaching Resources
Other Learning Resources: General
- Laboratory Interfaces
- Software
- Videodiscs
- Teacher Background

Other Learning Resources: Chemistry 20 (by Unit)
Other Learning Resources: Chemistry 30 (by Unit)
Distributor Addresses (alphabetical)

Basic student learning resources are those student learning resources authorized by Alberta Education as the most appropriate for addressing the majority of learner expectations of the course(s), substantial components of the course(s), or the most appropriate for meeting general learner expectations across two or more grade levels, subject areas or programs as outlined in provincial programs of study. These may include any resource format, such as print, computer software, manipulatives or video.

Support student learning resources are those student learning resources authorized by Alberta Education to assist in addressing some of the learner expectations of course(s) or components of course(s); or assist in meeting the learner expectations across two or more grade levels, subject areas or programs as outlined in the provincial programs of study. They may include any resource format, such as print, computer software, manipulatives or video.

Authorized teaching resources are those teaching resources produced externally to Alberta Education (for example, by publishers) that have been reviewed by Alberta Education, found to meet the criteria of review and to be the best available resources to support the implementation of programs of study and courses, and the attainment of the goals of education; they have been authorized by the Minister. Teaching resources produced as service documents by Alberta Education, such as the *STS Science Education: Unifying the Goals of Science Education*, 1990 monograph, and diagnostic programs, are authorized by definition.

Other learning resources are those learning resources identified by Alberta Education as useful for teachers in the implementation of a course(s) or program(s) of studies, but which have not undergone review procedures by Alberta Education. Alberta Education does not accept responsibility for use of these resources with students. It is the responsibility of the teacher to determine their suitability and application.

When searching for resources to support the science program you may want to check:

- Other departments within your school. Often, resources are useful for ideas in more than one subject area. For example, Junior High Science, Environmental and Outdoor Education (EOE), Social Studies, Career and Life Management (CALM), or English.
- School library for print or nonprint resources.
- ACCESS Network for many authorized teaching and support video resources.
- LRDC for most authorized teaching and support print resources and some nonprint resources.
- Government and nongovernment agencies for print and nonprint educational materials and/or background information.
- Distributor for print and nonprint resources.

Basic student learning resources are available through the Learning Resources Distributing Centre (LRDC). A *Buyers Guide* is also available.

Learning Resources Distributing Centre
12360 – 142 Street
Edmonton, Alberta
T5L 4X9
Telephone (403) 427–2767

Note: The information included is the most recent available at the time of document preparation. Prices of resources are as provided by distributors, May 1993. Check with distributor for current rates.

UNIT 1: MATTER AS SOLUTIONS, ACIDS, BASES AND GASES

A - Authorized Section
O - Other Section, Chemistry 20:
• by Unit
★ - Nonprint
● - Print

1. Solutions are homogeneous mixtures of pure substances.

O★Chemical Bonds: The World of Chemistry Series
O●Chemical Survey & Solutions and Pollution
O●Chemistry Counts: Practical Investigations
A★Dynamic Equilibrium: Chemical Equilibrium Series
O●Materials: Pathways Through Science Series
O●Pesticide Education Program
A★Water, Water Everywhere: Planet Under Pressure Series
O★What's on Tap? The Global Environment Series

2. Acids and bases have an effect on aqueous systems.

A★Acids and Bases: The World of Chemistry Series
O★Chemistry of the Earth: The World of Chemistry Series
O●Materials: Pathways Through Science Series
O★Proton in Chemistry (The): The World of Chemistry Series

3. A model of the gaseous state of matter provides insight into molecular behaviour.

A★Avogadro's Hypothesis: The Mole Concept Series
A★Combining Gas Volumes: The Mole Concept Series
A★Gas Volumes: The Mole Concept Series
A★Relative Mass: The Mole Concept Series

UNIT 2: QUANTITATIVE RELATIONSHIPS IN CHEMICAL CHANGES

A - Authorized Section
O - Other Section, Chemistry 20:
• by Unit
★ - Nonprint
● - Print

1. Balanced chemical equations indicate the quantitative relationships among reactants and products involved in chemical changes.

A★Gas Volumes: The Mole Concept Series
A★Haber Process (The): Chemical Equilibrium Series
A★Mole (The): The Mole Concept Series
O★Mole (The): The World of Chemistry Series
O★Mole (The): The World of Chemistry Series (High School Version)
A★Relative Mass: The Mole Concept Series

2. The relationships among amounts of reactants and products in chemical changes are used in quantitative analysis.

O★Catalysts: Science Topics
O★Catalysts and Catalytic Reactions: Chemistry: From Theory to Application Series
O●Investigating Chemical Processes: Your Island Factory

UNIT 3: CHEMICAL BONDING IN MATTER

A – Authorized Section
O – Other Section, Chemistry 20:
• by Unit
★ – Nonprint
● – Print

1. Chemical bonding in matter results in the formation of compounds.

O★Bonding, Part 2 (Dipole–Dipole, Hydrogen, van der Waals and Metallic Bonding)
O★Chemical Bonds: The World of Chemistry Series
A★Corrosion: Electrochemistry Series
O★Electron Arrangement: Electron Arrangement and Bonding Series
O★How Atoms Bond: Electron Arrangement and Bonding Series
O★Ionic and Covalent Bonding
O★Metals and Ionic Solids: Electron Arrangement and Bonding Series
O★Molecular Bonding: A Union of Atoms: Chemistry: From Theory to Application Series
O★Molecular Substance and Covalent Crystals: Electron Arrangement and Bonding Series
O★Silicon

UNIT 4: THE DIVERSITY OF MATTER: AN INTRODUCTION TO ORGANIC CHEMISTRY

A – Authorized Section
O – Other Section, Chemistry 20:
• by Unit
★ – Nonprint
● – Print

1. Organic compounds are a common form of matter.

O★Carbon: Chemistry: From Theory to Application Series
O★Carbon: The World of Chemistry Series
O★Carbon Chemistry
A★Carbon the Compromiser: Organic Chemistry I Series
A★Fixing Fuels: Organic Chemistry I Series
O●Making Materials: Pathways Through Science Series
O★Methane: The Simplest Hydrocarbon

2. The chemical changes of organic compounds are many and diverse.

O★Age of Polymers (The): The World of Chemistry Series
A★ASA: Organic Chemistry II Series
O★Chemistry of Soap
O★Colour: The World of Chemistry Series
A★Cosmetics: Organic Chemistry II Series
O●Environmental Choice Factsheets
O★Fibres: Organic Chemistry II Series
A★Glues: Organic Chemistry II Series
A★Harvest of Enzymes: Organic Chemistry I Series
O●Making Materials: Pathways Through Science Series
O★Petroleum: River of Energy
O★Plastics
O●Plastics in Our Lives
O★Polyethylene: Chemistry in Action Series
A★Polyethylene: Organic Chemistry I Series
O★Proteins: Structure and Function: The World of Chemistry Series
A★Reaction Kinetics: Chemical Equilibrium Series
A★Soaps and Detergents: Organic Chemistry II Series

UNIT 1: THERMOCHEMICAL CHANGES

A – Authorized Section
O – Other Section, Chemistry 30:
• by Unit
★ – Nonprint
● – Print

1. There are energy changes associated with changes to matter.

O★Fossil Fuels
O★Nuclear Power: Fission, Fusion and Their Applications

UNIT 2: ELECTROCHEMICAL CHANGES

A – Authorized Section
O – Other Section, Chemistry 30:
• by Unit
★ – Nonprint
● – Print

1. Many chemical changes involve the transfer of electrons.

O★Busy Electron (The): The World of Chemistry Series
A★Electrochemistry Series
O★Ions and Electrons in Metals: Chemistry: From Theory to Application
O★Oxidation–Reduction: The World of Chemistry Series

2. Energy is involved in electrochemical changes.

A★Electrochemistry Series
A★Redox

UNIT 3: EQUILIBRIUM, ACIDS AND BASES IN CHEMICAL CHANGES

A - Authorized Section
O - Other Section, Chemistry 30:
• by Unit
★ - Nonprint
● - Print

1. There is a balance of opposing reactions in chemical equilibrium systems.

O★Chemical Equilibrium
A★Chemical Equilibrium Series
O★Equilibrium: Chemistry: From Theory to Application Series
O★Molecules in Action: The World of Chemistry Series
A★Reversible Reactions and Dynamic Equilibrium: Senior High Science Series

2. Acid and base systems are quantitatively and qualitatively described.

A★Acids and Bases: The World of Chemistry Series

3. Acid–base chemistry involves proton transfer.

A★Acids and Bases: The World of Chemistry Series

Basic Student Learning Resources

Chemistry 20 and Chemistry 30

Addison-Wesley Chemistry, Third Edition, 1993

Format	Text	ISBN 0201602024
Annotation	A basic learning resource for Chemistry 20–30 covering the knowledge, skills and many of the suggested science–technology–society connections in the program of studies. The text contains problems and exercises for students to review; the answers are included at the back of the text.	
Price	$53.55	
Author	Anthony C. Wilbraham et al.	
Publisher	Addison-Wesley Publishers Limited	
Distributor	LRDC	106717

Chemistry at Work, 1991

Format: Videodisc and Image Directory

Annotation:

- More than 800 photos and 3-D computer graphics demonstrate practical applications in chemistry—processes in human and natural environments, actual photos of historical scientific persons, equipment and chemical materials.
- Approximately 30 short film/video segments, including the Hindenberg explosion, metallurgical processes and plant production of oxygen.
- Students can learn balancing equations along with other mathematical problem-solving skills necessary for understanding chemistry.
- Laboratory safety issues are covered, including handling acids, pouring, decanting, disposing of waste products and dealing with flammable materials.
- The periodic table data base presents a picture of each element, followed by the one or more common substances in which it is found. A printed, bar-coded periodic chart gives quick access to this data base.
- The user's manual identifies each image with a bar code and complete text of the disc narrative.

Price	$684	
Distributor	LRDC	240961

Nelson Chemistry, 1993

Format	Text	ISBN 0176038639
Annotation	A basic learning resource for Chemistry 20–30 covering the knowledge, skills and many of the suggested science–technology–society connections in the program of studies. New interest features and biographies related to chemistry are included in each chapter. Appendices have answers to overview questions, communication skills and laboratory processes.	
Price	$53.55	
Author	Frank Jenkins, Hans van Kessel, Dick Tompkins et al.	
Publisher	Nelson Canada	
Distributor	LRDC	106709

Physical Science: Cosmic Chemistry: The Living Textbook Series, 1991

Format	Videodisc
Annotation	*Cosmic Chemistry* deals with the abstract concepts critical to understanding the role of chemistry in everyday applications. Four, double-sided videodiscs are filled with still images, computer graphics, animations and movies. Topics range from interstellar elements and environmental cycles to the atomic and molecular structures of chemical compounds. There is a visual collection, including laboratory demonstrations performed by noted chemists, many of which cannot be replicated in the classroom. Laboratory safety is emphasized. Historical still images and archival movie footage include pioneering scientists and inventors, the bombing of Hiroshima, the explosion of the Hindenburg and a theatrical transformation of Dr. Jekyll into the character of Mr. Hyde. Sections of laboratory safety, consumer and environmental chemistry and the chemistry of the cosmos foster inquiry and informed decision making about a variety of issues. Topics covered are: Side 1: safety, atomic structure, nuclear chemistry Side 2: physical properties Side 3: chemical changes Side 4: metals, nonmetals Side 5: acids and bases, redox and electrochemistry Side 6: periodicity, organic chemistry Side 7: beauty and biochemistry, chemical consumption Side 8: atmospheric pollution, chemical hazards, cosmic chemistry
Price	$1075
Distributor	LRDC 240721

Physical Science: Principles of Physical Science: The Living Textbook Series, 1987

Format	Videodisc
Annotation	A two-videodisc set, this program provides more than 2500 slides, 300 diagrams, a 325-term visual glossary and 90 movie clips surveying physical science. Movie clips cover the structure of matter, including atomic theory and radioactivity; states of matter including solids, liquids and gases; the conservation of energy; mechanics, including Newton's and Kepler's laws with examples; wave motion; light and sound, including refraction, polarization and energy levels; electricity and magnetism, including an electrochemical cell, magnetization, electromagnetics and aurorae observations. Matter, motion and forces are covered on sides 1 and 2 and waves, electricity and magnetism on sides 3 and 4. Both videodiscs have curricular fit to Science 10, Chemistry 20–30, Physics 20–30 and Science 20–30.
Price	$1175
Distributor	LRDC 242876

Authorized Student Support/Teaching Resources

Acids and Bases: The World of Chemistry Series, 1989 — **Chemistry 20–30**

Format: Video (15 minutes)

Annotation: (*Authorized Student Support* for *Chemistry 20*)

The properties and reactions of acids and bases are examined, using real-world examples, such as the neutralizing action of antacid tablets and the problem of acid rain. PH is defined in a simplified manner. Also appropriate for Chemistry 30, Unit 2.

Price: Contact distributor

Distributor: ACCESS Network

Addison-Wesley Chemistry Ancillary Package, 1993 — **Chemistry 20–30**

Format: Print

	ISBN	LRDC No.	Price
Laboratory Manual 1: Student's Edition	020160213X	239039	$8.95
Small-scale Chemistry Laboratory Manual: Student's Edition	0201250063	239047	$13.20
Laboratory Manual 1: Teacher's Edition (SI Ed.)	0201602148	238940	$24.60
Teacher's Edition (Annotated Third Ed.)	0201282402	221979	$65.30
Small-scale Chemistry Laboratory Manual: Teacher's Edition	0201250071	238958	$18.40
Critical Thinking Worksheets (Masters)	0201250217	238966	$37.00
Daily Lesson Plans	0201250101	238974	$35.75
Skills Practice Book: Teacher's Edition (Masters)	0201250993	238982	$63.05
Tests and Quizzes (Masters)	0201250152	238990	$68.80
Teaching Diagram Transparencies, 1987	0201250284	239005	$163.95
Videodisc Bar Code Resource Book	0201810018	239013	$27.20
Issues in Chemical Technology: Teacher's Edition (Masters)	0201250241	239021	$9.50

Annotation: (*Authorized Student Support* and *Authorized Teaching Resource*)

An ancillary package addressing Chemistry 20–30 program requirements. Each book covers a different area of the program. The two student resources address laboratory skills and investigations.

Author: A. C. Wilbraham et al.

Distributor: LRDC

Addison-Wesley Chemistry Laboratory Manual 2, 1993 **Chemistry 20**

Format: Print
Student's Edition ISBN 0201606976
Teacher's Edition 0201606968

Annotation: (*Authorized Student Support* and *Authorized Teaching Resource*)

A laboratory manual supporting the authorized basic textbook, *Addison-Wesley Chemistry, Third Edition*, 1993 for the Chemistry 20–30 program.

Price: $8.90 Student's Edition
$21.45 Teacher's Edition

Distributor: LRDC 252932 (student's edition)
252940 (teacher's edition)

ALCHEM 2000 Chemistry: Science, Technology, Society, Revised Edition, 1990 **Chemistry 20–30**

Format: Print ISBN 0920008313

Annotation: (*Authorized Student Support*)

Student text (revised edition): a resource supporting the Chemistry 20–30 Program of Studies. ALCHEM presents a strong emphasis on practical applications in chemistry, using the science–technology–society approach. The laboratory experiments are integrated throughout the text.

Price: $58.30

Author: John E. Smith et al.

Distributor: LRDC 241084

ALCHEM 2000 Chemistry: Science, Technology, Society, 1993 **Chemistry 20–30**

Format: Print
Book 1 ISBN 0920008518
Book 2 0920008526

Annotation: (*Authorized Student Support*)

These manuals support the Chemistry 20–30 Program of Studies. They include labs and exercises for students to complete. There is an emphasis on practical applications in chemistry, using the science–technology–society approach.

Price: $9.75 each

Author: Harry B. Herzer et al.

Distributor: LRDC 241076 (book 1)
241068 (book 2)

Asimov's Chronology of Science and Discovery, 1989 **Chemistry 20–30**

Format	Print	ISBN 0060156120
Annotation	*(Authorized Teaching Resource)*	
	From 4 000 000 BCE to the present, the significant events in astronomy, exploration, biology, physics, chemistry and mathematics are described. Asimov illustrates how scientific, cultural, social and political events affected each other. Discoveries and inventions are categorized by year of discovery against a backdrop of world history, and show how science influenced the world and how the world has responded to scientific advances.	
Price	$28.55	
Author	Isaac Asimov	
Distributor	LRDC	261412

Atlas of Environmental Issues, 1989 **Chemistry 20**

Format	Print	ISBN 081602023X
Annotation	(*Authorized Student Support* for *Environmental and Outdoor Education*)	
	Describes and explains major environmental issues of today's world, including soil erosion, deforestation, mechanized agriculture, oil pollution of oceans, acid rain, overfishing and nuclear power. Excellent graphics.	
Price	$22.88	
Author	Nick Middleton	
Distributor	Facts On File	

Career Connections Series, 1993 **Chemistry 20–30**

Format: Print

Annotation: *(Authorized Student Support)*

Summary: This series outlines the educational background needed to qualify for different careers in a variety of areas. Personal profiles and comments from individuals are featured.

Great Careers for People Interested in How Things Work
Author: Peter Richardson and Bob Richardson ISBN 1895579082

Describes careers such as: inventor, chemical research analyst, automotives mechanic.

Great Careers for People Interested in the Human Body
Author: Lois Edwards ISBN 1895579066

Describes careers such as: family physician, respiratory technologist, community health nurse.

Great Careers for People Who Like Being Outdoors
Author: Helen Mason ISBN 1895579104

Describes careers such as: park naturalist, practical forester, farmer.

Great Careers for People Concerned About the Environment
Author: Lesley Grant ISBN 189557904X

Describes careers such as: environmental chemist, lawyer, health specialist.

Great Careers for People Interested in Math and Computers
Author: Peter Richardson and Bob Richardson ISBN 1895579023

Describes careers such as: mathematics consultant, video games programmer, audio engineer.

Great Careers for People Interested in Living Things
Author: Julie Czerneda ISBN 1895579007

Describes careers such as: plant scientist, museum biologist, equestrian coach.

Price: Contact distributor

Distributor: LRDC

Chemical Equilibrium Series, 1984 **Chemistry 20–30**

Format: Six, 10-minute videos

Annotation: (*Authorized Student Support* for *Chemistry 30*)

Summary: This series uses analogy and computer animation to introduce the concepts of chemical reactions. It examines the theories of steady state, dynamic equilibrium, kinetic molecular theory, reaction tendencies, and the equilibrium constant. The forward and reverse reactions of various chemical changes are illustrated, including the production of hydrogen iodide, hydrogen chloride and ammonia. Finally, through demonstrations of Le Chatelier's principle and the Haber–Bosch process, students gain a better understanding of the importance of chemical equilibrium.

Unsteady Steadiness VC324701
This program explores the direction of chemical reactions by following endothermic and exothermic reactions to their completion. This leads to a comparison of steady state, closed systems and equilibrium reactions.

Dynamic Equilibrium VC324702
This program describes how all chemical reactions operate in two directions, using hydrogen iodide as an example. It uses a collision model, based on the kinetic molecular theory, to explain how molecules behave during dynamic equilibrium. Also appropriate for Chemistry 20, Unit 1.

Reaction Kinetics VC324703
Investigates why some chemical reactions happen more quickly than do others. A chain mechanism model demonstrates how energy released by reacting molecules influences the reaction, and leads to an understanding of exothermic and endothermic reactions.

Reaction Tendencies VC324704
Introduces Le Chatelier's principle, which states that if a system in equilibrium is subject to stress, the system tends to react in such a way as to oppose the effect of the stress. Two types of stress are examined: change in temperature and change in pressure/volume. Also appropriate for Chemistry 20, Unit 4.

The Equilibrium Constant VC324705
A dance analogy is applied to the hydrogen iodide reaction to illustrate how shifts in equilibrium occur. The program states that qualitative predictions are not enough, and then illustrates how chemists are able to ascertain the equilibrium constant, quantitatively, by using a simple mathematical model.

The Haber Process VC324706
The program outlines the development of the process invented by Fritz Haber for producing ammonia from atmospheric nitrogen. The program recounts the major events of Haber's life, explaining how his discoveries affected the first World War. Also appropriate for Chemistry 20, Unit 2.

Price: Contact distributor

Distributor: ACCESS Network

Chemistry, Fifth Edition, 1994 **Chemistry 20–30**

Format Print ISBN 0070110034

Annotation (*Authorized Teaching Resource*)

This text provides a foundation in chemical concepts and principles. Applications that emphasize the relevance of chemistry to biology, medicine, technology, engineering and current events are used throughout.

Price $81.50

Author Raymond Chang

Distributor LRDC 265406

Chemistry of Solutions: Program 12, 1992 **Chemistry 20**

Format Video (10 minutes)

Annotation (*Authorized Student Support*)

Several solutions and their unique combinations of solutes and solvents are studied. Two teenage hosts conduct laboratory demonstrations and describe computer animated sequences.

Price Contact distributor

Distributor ACCESS Network BPN 302212

Dudley Herschbach: Chemical Reactions Atom by Atom: Nobel Prize Series, 1990 **Chemistry 30**

Format Video (20 minutes)

Annotation (*Authorized Student Support*)

This program on Dudley Herschbach consists of a videotape, student notebook and teacher resource book. Herschbach and his work is introduced through a brief, informative interview and scenes from his public and private life. He received the 1986 Nobel Prize in Chemistry. The prize was shared with John Polanyi and Yuan T. Lee, with whom he has collaborated. Some scientists are awarded the Nobel prize for single experiments that create a fundamental change in the understanding of a phenomena. Others, like Herschbach, steadily develop and enlarge scientific understanding over a long period of time. Herschbach's contribution was a new way of studying chemical interactions. His research involved the chemistry of individual molecules.

Price $70.30

Distributor LRDC 240789

Electrochemistry Series, 1986 **Chemistry 30**

Format: Six, 10-minute videos

Annotation: (*Authorized Student Support*)

Summary: Introduces the battery and explains the basic principles involved in its operation. Also illustrates the terminology and processes of electrochemical reactions, how half-cell potentials can be determined, and how electrochemistry is at work in the commercial Leclanché cell, as well as the processes of corrosion and electrolysis. Animation is used throughout the series.

The Building Blocks of Electrochemistry VC324801
Basic concepts of electrochemistry are introduced with the aid of a robot powered by an electrochemical cell. The chemical reactions occurring inside the cell demonstrate the principles of reduction and oxidation that produce the flow of electrons in the cell.

Electrochemical Cells VC324802
The operation of an electrochemical cell is shown with a laboratory model of a zinc–copper cell. Animation is used at the atomic level to show that differences in activity levels determine the effectiveness of the electrochemical cell.

Designing Electrochemical Cells VC324803
This program shows how to build a superelectrochemical cell by explaining the need for a standard half-cell, how to predict the direction of the electron flow, and how a table of reduction potentials can predict the output of a cell.

Commercial Electrochemical Cells VC324804
This program demonstrates how chemical reactions studied in previous programs apply to commercially available batteries. The development of the modern battery is traced, highlighting the discoveries of Galvani and Volta, the Leclanché cell, and rechargeable cells.

Corrosion VC324805
This program is an investigation of the question: Why does rust develop? The oxidation–reduction reaction that produces corrosion is shown, explaining the role of the electrochemical cell. Ways to prevent and control corrosion by galvanization and cathodic protection are illustrated. Also appropriate for Chemistry 20.

Electroplating VC324806
The causes and results of electrolysis, a nonspontaneous reaction requiring a source of electrical energy, are explained. By studying the reduction potentials for each possible half-cell reaction a prediction can be made as to which reaction will occur.

Price: Contact distributor

Distributor: ACCESS Network

Heath Chemistry, Canadian Edition, 1993 **Chemistry 20–30**

Format	Print	
	Student Text	ISBN 066920367X
	Teacher's Edition	0669299634
Annotation	(*Authorized Student Support* and *Authorized Teaching Resource*)	
	This text focuses on understanding basic chemistry principles, with special emphasis on proportional reasoning in calculations.	
Price	$58.45 Student Text $76.40 Teacher's Edition	
Author	J. Dudley Herron et al.	
Distributor	LRDC	237330 (student text) 237322 (teacher's edition)

Invitations to Science Inquiry, Second Edition, 1992 **Chemistry 20**

Format	Print	ISBN 187810621X
Annotation	(*Authorized Teaching Resource* for *Science 10* and *Science 20–30*)	
	Discrepant events are set up in such a way as to pose questions and ask for explanations. The description of discrepant events is organized to provide guidance for conducting a science inquiry. Emphasis has been placed on the use of simple material so that most of the events can be carried out with things that are found in everyday life or can be bought in local stores.	
Price	$56	
Author	Tik Liem	
Distributor	LRDC	242313

Mole Concept Series (The), 1983 **Chemistry 20**

Format: Six, 10-minute videos

Annotation: (*Authorized Student Support*)

Summary: Outlines the historical development of the mole concept. The mole is the standard for directly comparing large numbers of atoms. Enhances the understanding of chemical reactions at the molecular level. Each program uses animation from the real world to clarify the material. Exercises in reasoning, using Gay-Lussac's law of combining gas volumes and Avogadro's hypothesis, encourages class discussion. Through a process of postulation and refutation, students discover a practical working tool for comparing atoms in chemical reactions.

Relative Mass VC289401
The program examines the method of comparing the masses of atoms in order to understand how they differ from one another. The example of two truckloads of pigs and turkeys shows how relative mass can be determined and how the same principle can apply to calculating the relative mass of atoms.

Gas Volumes VC289402
The program discusses the concept of gas volume as a possible method for measuring the mass of atoms. A concert hall serves as a model for measuring the mass of atoms, as it has a fixed number of seats, which always hold the same number of people.

Combining Gas Volumes VC289403
Using the gas volume hypothesis, the program examines how a single atom behaves. A prediction is made about the behaviour of atoms in gases. This is compared to Gay-Lussac's law of combining gas volumes.

Avogadro's Hypothesis VC289404
Advances Avogadro's hypothesis that equal volumes of gas at the same temperature and pressure can contain equal numbers of particles. It also examines Avogadro's assertion that each particle of gas can contain no fewer than two atoms and that each particle could be called a "molecule".

Relative Atomic Mass VC289405
The program introduces the mass spectrometer, the modern method of measuring atomic mass. It uses the analogy of cars of various masses travelling at a fixed speed to illustrate the function of the mass spectrometer.

The Mole VC289406
Introduces the mole as the standard for comparing large numbers of atoms and gas volumes. Avogadro's number is introduced.

Price: Contact distributor

Distributor: ACCESS Network

Nelson Chemistry: Solutions Manual, 1993 **Chemistry 20–30**

Format	Print	ISBN 0176039767
Annotation	(*Authorized Teaching Resource*)	
	This manual includes complete solutions to all questions in *Nelson Chemistry*. Exercise questions are included within each chapter as well as overview questions at the end of each chapter. The manual provides a model that meets curriculum requirements.	
Author	Frank Jenkins, Hans van Kessel, Dick Tompkins, Michael V. Falk, Oliver Lantz, Michael Dzwiniel and George H. Klimiuk	
Price	$64.30	
Distributor	LRDC	238776

Nelson Chemistry: Teacher's Edition, 1993 **Chemistry 20–30**

Format	Print	ISBN 0176038647
Annotation	(*Authorized Teaching Resource*)	
	This teacher's edition features a description of science–technology–society emphasis, weekly and daily schedules, audio-visual resources, teacher references, classroom resources, and technical details for setting up each investigation and mini-demonstration.	
Price	$85.70	
Author	Frank Jenkins, Hans van Kessel, Dick Tompkins, Michael V. Falk, Oliver Lantz, Michael Dzwiniel and George H. Klimiuk	
Distributor	LRDC	238784

One-Minute Readings: Issues in Science, Technology, and Society, 1992 **Chemistry 20–30**

Format	Print	
	Student Book	ISBN 0201231573
	Teacher Manual	020123159X
Annotation	(*Authorized Student Support* and *Authorized Teaching Resource*)	
	Contains readings and questions related to issues in science, technology and society. Applications of science are raising tough questions and are creating problems that cannot yet be answered. The book gives practice in making the kinds of decisions experienced in life. Students need a knowledge of science to find not necessarily the right answers, but the best possible answers.	
Price	$10.70 Student Book $8.50 Teacher Manual	
Author	Richard F. Brinckerhoff	
Distributor	LRDC	105628 (student book) 105636 (teacher manual)

Format: Six, 10-minute videos

Annotation: (*Authorized Student Support*)

Summary: This series investigates the properties and structure of carbon and some of its uses—in fuels, plastics and industry. Computer animation is used to illustrate bonding and reaction at the molecular level, and helps simplify complex concepts.

Carbon the Compromiser VC324901
A chronicle of early breakthroughs in chemistry includes the discovery of covalent bonds and a method to produce organic compounds. Covalent bonds are defined, and two-dimensional computer animation shows how they are formed.

The Shape of Carbon VC324902
The planetary and quantum models of the atom are compared, and computer animation is used to illustrate the concept of bonding and the stability of some carbon compounds.

Carbon Bonding VC324903
This examination of the nature of carbon bonds includes sigma bonds, which are relatively stable, and pi bonds, which are slightly weaker. Computer animation illustrates the complex structure of double bonds formed by carbon atoms.

Fixing Fuels VC324904
A look at common fossil fuels and the possible nonbiological origin of methane. Through an examination of butane, the concept of isomers is developed, methods of removing impurities from natural gas are examined, and fractional distilling of petroleum is studied.

Polyethylene VC324905
This is the history and development of polyethylene, beginning with an experiment conducted in Britain in the 1930s. The program looks at how polyethylene is processed and manufactured to create light, durable and chemically inert products.

Harvest of Enzymes VC324906
The relationship between the structure and function of enzymes in the human body illustrates why the enzyme is so essential to commercial applications in industry.

Price: Contact distributor

Distributor: ACCESS Network

Format: Five, 10-minute videos

Annotation: (*Authorized Student Support*)

Summary: A sequel to *Organic Chemistry I*, this series uses three-dimensional animation to show how the molecules and properties of compounds apply to a wide variety of industrial applications. Since the number of synthetic compounds being developed is steadily increasing, the series concludes with a program on the benefits and risks of these materials.

Soaps and Detergents
The composition of today's soaps and detergents is examined at the molecular level, and their chemical properties are linked to their cleaning powers.

Glues
The bonding processes of glues, chemical polymerization and physical interlocking are examined, as well as consumer and industrial needs.

ASA
The development of acetylsalicylic acid is traced back to its derivative in the willow tree. The program examines some of the side effects of ASA use.

Cosmetics
The chemistry of lipstick is explored. The program discusses how the physiology of the skin determines the specifications of a product, which must promote beauty and yet not impair the health of the lips.

Life After Chemistry
The program shows how dioxin enters the ecosystem and the research methods used to dispose and recycle this chemical.

Price: Contact distributor

Distributor: ACCESS Network

Perspectives in Science Series, 1989 **Chemistry 20–30**

Format: Laserdisc; Videocassette; Videodisc

Annotation: (*Authorized Student Support*)

This series begins with a 30-minute introductory video, The Program in Action, and then three, one-hour interactive videos exploring the topics biotechnology, toxic waste and water. The series develops critical thinking about science, technology and society, examines basic applications, and points out unforeseen problems or complications often emerging as a consequence. Introductions contain docudramas with strong language and confrontation.

Price: $345 Videodisc

Distributor	
Technovision Inc.	Laserdisc
National Film Board of Canada	Videocassette
Technovision Inc.	Videodisc

Redox, 1992 **Chemistry 30**

Format: Video (27 minutes)

Annotation: (*Authorized Student Support*)

The following concepts are summarized:

- chemical reactions involving the transfer of electrons
- reduction and oxidation are complementary and opposite
- oxidizing agents
- oxidation number
- reducing agents
- half equations
- balancing redox equations
- standard redox potentials
- spontaneous electrochemical reactions
- forced electrochemical reactions
- examples—corrosion, electroplating, bleaching, batteries, fuel cells.

Price: $65.75

Distributor: LRDC 244848

Reversible Reactions and Dynamic Equilibrium: Senior High Science Series, 1992 — **Chemistry 30**

Format: Video (10 minutes)

Annotation: (*Authorized Student Support*)

The state of dynamic equilibrium reactions is discussed, using laboratory demonstrations and computer animated sequences. Equilibrium is made observable through the addition of a reactant change of pressure and change of temperature.

Price: Contact distributor

Distributor: ACCESS Network BPN 30221

Science Process and Discovery — **Chemistry 20–30**

Format: Print
Text, 1985 ISBN 0201186284
Teacher's Guide, 1989 0201186314

Annotation: (*Authorized Teaching Resource*)

- Examines significant events in the history of science and topics of current research through the use of short case studies.
- Written for the general-level science student, but allows deeper analysis of the scientific method for the more advanced student.
- Short narrative articles are followed by two different question sets.
- Analysis provokes thinking about the cycle of proof and scientific principles.
- Accompanying teacher's guide contains objective questions for each narrative.

Price: $17.65 Text
$23.65 Teacher's Guide

Author: Dennis Field

Distributor: LRDC 236374 (text)
238403 (teacher's guide)

Senior High Science Video Series, Programs 1–5, 1990 **Chemistry 20–30**

Format: Video

Annotation: (*Authorized Student Support*)

Program 1: Baking Better Science BPN 302201
Program 2: Zapped BPN 302202
Program 3: Teaching from the STS Approach: The Nature of Science BPN 302203
Program 4: Teaching from the STS Approach: Science and Technology BPN 302204
Program 5: Teaching from the STS Approach: The Social Context of Science and Technology BPN 302205

Programs 2 to 5 are teacher inservice video programs and are available on one tape.
Programs 3 to 5 show teachers practising science–technology–society strategies and interviewing educators and students about these methods. The teachers involved were practising the strategies in their classrooms in the fall of 1990—before implementation of most of the new programs, Science 14–24 being the exception.

Price: Contact distributor

Distributor: ACCESS Network

Water, Water Everywhere: Planet Under Pressure Series, 1992 **Chemistry 20, Unit 1**

Format: Video (20 minutes)

Annotation: (*Authorized Student Support* for *Biology 20* and *Science 20–30*)

A look at the properties of water and its chemical and physical abilities to dissolve and transport minerals and nutrients. A sewage treatment operation is examined, and the problems of hazardous waste are discussed. The phrase, "Poison, the lifeblood of the planet," which reflects humankind's impact on the Earth, could be discussed from a variety of perspectives.

Price: Contact distributor

Distributor: ACCESS Network

Other Learning Resources: General

The resources identified below have not been evaluated by Alberta Education. These listings are not to be construed as an explicit or implicit departmental approval for use. They are provided as a service only to assist school authorities to identify resources that contain potentially useful ideas. The responsibility to evaluate these resources prior to selection rests with the user, in accordance with any existing local policy.

Note: Prices of resources are listed as provided by distributors, May 1993. Check with distributor for current rates.

Laboratory Interfaces

Champ II — **Chemistry 20–30**

Format	MS–DOS and Macintosh
Annotation	Users perform/analyze experiments using probes, software and computer hardware.
Price	Contact distributor
Distributor	Merlan Scientific

Leap — **Chemistry 20–30**

Format	MS–DOS/Apple II/Macintosh
Annotation	Users perform/analyze experiments using probes, software and computer hardware. Interdisciplinary Lab Pac (physics/chemistry) and Biology and Principles of Technology Lab Pac (applied physics) are available. Lab pacs include manuals, interface card, software and several probes/cables.
Price	Contact distributor
Distributor	Quantum Technology Inc.

Personal Science Lab — **Chemistry 20–30**

Format	MS–DOS
Annotation	Users perform/analyze experiments using probes, software and computer hardware.
Price	Contact distributor
Distributor	Contact local software outlet

Software

Chemistry 20 Assessment Resources Package (Item Bank) **Chemistry 20**

Format: LXR test format and print

Annotation: Consists of four unit examinations and one year-end examination for Chemistry 20. Two formats are available:

- LXR test format (Macintosh) on five, 3½" discs
- print format, user's guide and accompanying graphics.

Also see *Science 20 Assessment Resources (ASCII Format)*, 1993.

Price: $11.15

Distributor: LRDC 237976

LXR Test **Chemistry 20–30**

Format: Macintosh

Annotation: Test-generating program in three versions: personal, professional and scoring editions. The item banks on the Scoring Edition take full advantage of its additional features; however, they also work with the other two editions. For novices, there may be some "challenges" associated with using the Personal Edition.

Price: $599 U.S. (Site Licence) Personal
$799 U.S. (Site Licence) Professional
$999 U.S. (Site Licence) Scoring

Distributor: Logic eXtension Resources

Science 20 Assessment Resources (ASCII Format), 1993 **Chemistry 20**

Format: MS–DOS (ASCII text format)
Macintosh (ASCII text format)

Annotation: MS–DOS includes four unit examinations and one final examination on a 3½" disc, as well as print material, user's guide and accompanying graphics for Biology 20, **Chemistry 20**, Physics 20 and Science 20.

Macintosh includes four unit examinations and one final examination on five, 3½" discs, as well as print material, user's guide and accompanying graphics for Biology 20, **Chemistry 20**, Physics 20 and Science 20.

Price: $21 each

Distributor: LRDC 237869 (MS–DOS)
237835 (Macintosh)

Videodiscs

Doing Chemistry, 1987 **Chemistry 20–30**

Format: Videodisc

Annotation: This product of the American Chemical Society contains 122 experiments and demonstrations. The activities are based on feedback from workshops and reviews by safety experts.

The disc can be used to introduce the laboratory, show materials, equipment set-up, laboratory techniques and safety precautions. They may substitute for laboratory experiences for which time or equipment is not available. It provides time, materials, hints, hazards, disposal, introductory sets, question sets and answers, presentation questions, sample data, classroom copy masters, closure questions and practical applications.

Includes HyperCard software, a laboratory interfacing program for the Apple II, and a 600-page teacher's manual with textbook cross-references and complete instructions for each experiment.

Price: $798

Distributor: Videodiscovery Inc.

Our Environment, 1990 **Chemistry 20–30**

Format: Videodisc

Annotation: Contained are 6000 environmental colour photos sequenced with explanatory captions, maps, diagrams and film segments. The disc includes:

- the four spheres of air, water, land and organisms
- a focus on important environmental problems, such as acid rain, energy usage, climate change, desertification, wetlands loss, tropical deforestation, oil spills, nuclear power and weapons, soil erosion, solid waste, species extinction, asbestos and water pollution
- a visual glossary illustrating over 700 environmental terms and surveying the globe with captioned photos.

Price:
$395 U.S. Videodisc
$30 U.S. Teacher Manual
$15 U.S. Student Manual
$70 U.S. HyperCard Stacks

Distributor: Optilearn

Teacher Background

Canadian Environmental Education Catalogue: A Guide to Selected Resources and Materials, 1991 — **Chemistry 20**

Format	Print
Annotation	Contains a list of environmental resources.
Price	$20 main volume $40 two-year subscription (main volume plus supplementary volumes, one every 6 to 8 months)
Distributor	Pembina Institute

Chemistry: Experimental Foundations, 1987 — **Chemistry 20**

Format	Print	ISBN 0131290819
	Teacher's Guide	0131291157
Annotation	The spiral approach is used in covering key concepts in chemistry. The text also contains chapters on environmental problems and planetary and interstellar chemistry.	
Price	Contact distributor	
Author	Robert W. Parry et al.	
Distributor	Prentice-Hall Canada Inc.	

Chemistry: A First Course, 1987 — **Chemistry 20–30**

Format	Print	ISBN 020117880X
Annotation	This introductory text presents the basic concepts of chemistry, using numerous practical examples. The text examines some of the major social issues confronted by the Canadian chemical industry.	
Price	$34.20	
Author	Geoffrey Rayner-Canham and Arthur Last	
Distributor	Addison-Wesley Publishers Limited	

Chemistry: A Human Venture, 1988 **Chemistry 20**

Format	Print	ISBN 0772516960
	Laboratory Manual	0772517258
Annotation	The text explores the processes by which knowledge has been acquired. Chemical knowledge is a result of the contributions of many people over a long period of time. The historical development of several topics has been included to reinforce the idea that chemical knowledge is tentative in nature and subject to continual revision. Applications of chemistry and their impact on society are also examined.	
Price	Contact distributor	
Author	Stan Percival and Ross Wilson	
Distributor	Irwin Publishing Inc.	

Chemistry: A Second Course, 1988 **Chemistry 20–30**

Format	Print	ISBN 0201178850
Annotation	This text is written for a senior-level high school chemistry course. The relevance of chemistry is emphasized by examining some current environmental questions.	
Price	Contact distributor	
Author	Geoffrey Rayner-Canham and Arthur Last	
Distributor	Addison-Wesley Publishers Limited	

Chemistry Now, 1989 **Chemistry 20**

Format	Print	ISBN 0199142391
Annotation	Chemistry involves every aspect of daily life. Chemists create new materials and test existing ones for purity or safety. Each section of the book shows how chemistry is involved in everyday life.	
Price	Contact distributor	
Author	Richard Hart	
Distributor	Oxford University Press	

Chemistry Today 1, Third Edition, 1988 **Chemistry 20**

Format	Print	ISBN 0131293060
	Laboratory Manual	0131293214
	Teacher's Guide	0131293141
Annotation	The text, laboratory manual and teacher's guide cover major topics in science as they apply to everyday life.	
Price	Contact distributor	
Author	R. L. Whitman, E. E. Zinck and R. A. Nalepa	
Distributor	Prentice-Hall Canada Inc.	

Complete Handbook of Science Fair Projects (The), 1991 **Chemistry 20**

Format	Print	ISBN 0471527297(c)
		0471527289(p)
Annotation	Contains 50 award-winning projects from actual science fairs, described in detail with accompanying illustrations and 500 other suggested science fair topics suitable for junior and senior high science students. Detailed guidelines for preparing a science fair project are outlined. This includes selection of topic, obtaining materials, recording data and suggestions for oral presentation.	
Price	$18.50	
Author	Julianne Blair Bochinski	
Distributor	John Wiley & Sons Canada Ltd.	

Conservation Strategy, 1988 **Chemistry 20–30**

Format: Print (pamphlets)

Annotation: This series of discussion papers covers:

- Tourism in Alberta
- Agricultural Considerations for Today and Tomorrow
- Healthy Planet, Healthy People
- Oil and Gas in Alberta: An Uncertain Future
- Foundations for the Future: Alberta's Mineral Resources
- Energy Conservation: A Goal for Albertans
- Renewable Energy: The Power and the Potential
- Environment by Design
- Reserves for Nature
- A Place for Wildlife
- Environmental Education for a Sustainable Future
- Dinosaurs and Distant Drums
- Perspectives for an Alberta Conservation Strategy
- Resolving Conflict: A Case Study
- Alberta Conservation Strategy: Strategic Framework in Action
- Alberta Conservation Strategy: Strategic Framework in Brief
- Alberta Wetlands: Water in the Back
- Our Dynamic Forests: The Challenge of Management
- People, Parks and Preservation
- Electricity: Development for a Sustainable Future
- Saving the Strands of Life: Alberta's Biodiversity.

Price: Free

Author: Alberta Conservation Strategy Project

Distributor: Environmental Council of Alberta

CRC Handbook of Hazardous Laboratory Chemicals: Information and Disposal, 1991 **Chemistry 20**

Format: Print ISBN 084930265X

Annotation: This handbook has information about physical properties, fire hazards, chemical properties, hazardous reactions, physiological properties and health hazards, spillage disposal, waste disposal, and appropriate reactions to spillage and waste disposal.

Price: $95 U.S.

Author: M. A. Armour

Distributor: CRC Press

Destination Conservation, 1990 **Chemistry 20**

Format: Print

Annotation: This manual was written especially for schools seeking to improve their energy, water and waste management practices, and covers:

1. The Program Begins
   - Initial Awareness Activities
   - Determining Energy and Resource Consumption Levels
2. Taking Action
   - Energy Audit and Action Plan
   - Conservation Campaign
   - Resource Audit and Action Plan
3. Further Awareness and Action
   - A Global Perspective
   - Individuals Can Make a Difference
   - Environmental Connections
   - Overpopulation
   - Energy and the Environment
   - Transportation
   - Global Warming/Greenhouse Effect
   - Ozone Layer Depletion
   - Deforestation
   - Water Conservation
   - Ecological Landscaping and Gardening
   - Waste Management
   - Cost Recovery Program for Paper
   - Hazardous Materials

Price: $35

Distributor: Environmental Resource Centre

Energy Alternatives: Transparency Masters and Discussion Notes **Chemistry 20–30**

Format: Print

Annotation: The materials in this resource focus on making the best choices to meet Canada's future energy needs. Forms of energy alternatives are examined, as well as the advantages and disadvantages of each energy source. Decisions to determine which energy sources should be pursued, and where facilities should be located, are very complex in nature. Each of eight sections contains information about current technologies, and national and international energy resources research. Transparency masters can be used to initiate discussion.

Price: Free

Distributor: P. J. Spratt & Associates Inc.

Environmental Issues/An Overview, 1989 **Chemistry 20**

Format: Print

Annotation: The Canadian Association of Petroleum Producers has published a series of pamphlets on important environmental issues, including sour gas, waste management, water quality and oil spills in Canada's frontiers. This particular pamphlet is an overview of the industry's concern for environmental matters, research and safety, industry and the community, industry and the government, and industry and the economy.

Price: Free

Distributor: Canadian Association of Petroleum Producers

Environmental Science Activities Kit, 1993 **Chemistry 20–30**

Format: Print ISBN 0876283040

Annotation: This book contains a collection of hands-on classroom activities promoting the understanding of natural and human-made environments; and awareness of environmental problems and their solutions.

Price: $27.95 U.S.

Author: Michael L. Roa

Distributor: Center for Applied Research in Education (The)

Experiments in General Chemistry: Saunders Golden Sunburst Series, 1992 **Chemistry 30**

Format: Print
Text ISBN 0030751632
Instructor's Manual 0030751586

Annotation: This manual provides an introduction to most of the laboratory techniques used by all chemists. Written descriptions are illustrated with art work. Procedures for each experiment are described in step by step detail.

Price: $29.95 Text
$40.95 Instructor's Manual

Author: Carl B. Bishop, Kenneth W. Whitten and Kenneth D. Gailey

Distributor: Harcourt Brace and Company Canada

Focus on Research: A Guide to Developing Students' Research Skills, 1990 — **Chemistry 20–30**

Format	Print
Annotation	Outlined is a resource-based research model to help manage information efficiently and effectively, and gain transferable skills to all work situations. The model provides a developmental approach to doing research.
Price	$4.10
Author	Alberta Education
Distributor	LRDC 161802

Foundations of Chemistry, Second Edition, 1990 — **Chemistry 20–30**

Format	Print ISBN 003922287X Laboratory Manual 0039225003
Annotation	Discusses how chemical principles and concepts are developed from experimental observations and data and how these principles can be used to explain certain phenomena. Development of solutions to quantitative and qualitative problems through investigation and verification is emphasized.
Price	Contact distributor
Author	Ernest R. Toon et al.
Distributor	Harcourt Brace and Company Canada

Fundamentals of Chemistry: General, Organic and Biological, 1988 — **Chemistry 20**

Format	Print ISBN 0673165914 Transparency Acetates 0673172597
Annotation	Each chapter in the text relates to health care and the chemical operation of the body as well as the basic principles of chemistry.
Price	Contact distributor
Author	Joseph D. Deleo
Distributor	Gage Educational Publishing Company

General Chemistry, Fourth Edition:
Saunders Golden Sunburst Series, 1992 **Chemistry 20–30**

Format	Print	
	Text	ISBN 0030723736
	Solutions Manual	0030751624
	Study Guide	0030751616
Annotation	An advanced placement text that offers complete coverage of descriptive chemistry and principles. The solutions manual emphasizes the reasoning behind the mathematical manipulations. The study guide contains: chapter summaries, study goals, terms and pre-test and answers.	
Price	$67.95 Text $24.95 Solutions Manual $26.95 Study Guide	
Author	Kenneth W. Whitten, Kenneth D. Gailey and Raymond E. Davis	
Distributor	Harcourt Brace and Company Canada	

Health and Safety on the Job: Audio-visual Catalogue, 1992 **Chemistry 20**

Format	Print
Annotation	Lists several audio-visual resources available from the Alberta Labour Library.
Price	Free
Distributor	Alberta Labour Library

How Safe Is Enough? 1983 **Chemistry 20–30**

Format: Video (18 minutes)

Annotation: This program is an introduction to risk–benefit analysis. The following concepts are discussed by a group of three students and an instructor:

- most human activities involve some risk
- a number of activities are ranked according to the number of deaths they cause in Canada
- risk perceptions vary from person to person. Inaccurate evaluations are dependent on preconceptions due to personal experience
- risk analysis involves estimating the consequences of risks and the probability of their occurrence, a mathematical equation is derived
- risk analysis assists in the decision-making process of individuals.

The video is accompanied by a teacher's guide entitled *On the Perception, Estimation and Evaluation of Risk.*

Price: Contact distributor

Distributor: P. J. Spratt & Associates Inc.

Introducing Chemistry: The Salters' Approach, 1988 **Chemistry 20–30**

Format: Print ISBN 0435640003

Annotation: This approach to chemistry is simply putting chemistry into context as each topic is based on aspects of everyday life.

Price: Contact distributor

Author: Graham Hill et al.

Distributor: Irwin Publishing Inc.

Introduction to Chemical Principles, Fifth Edition: Saunders Golden Sunburst Series, 1990 **Chemistry 20**

Format:

Print	ISBN 0030302641
Instructor's Manual	0030302692
Laboratory Manual	0030029236
Test Bank	0030306787

Annotation: Includes questions and examples of problems in basic chemistry.

Price: Contact distributor

Author: Edward I. Peters et al.

Distributor: Harcourt Brace and Company Canada

Levitating Trains and Kamikaze Genes: Technological Literacy for the 1990s, 1991 — **Chemistry 20**

Format	Print ISBN 0060973692
Annotation	This is a guide to technological literacy with a list of topics on space technology, biotechnology, computer literacy, energy, superconductivity, high technology, health and transportation.
Price	$11.95
Author	Richard P. Brennan
Distributor	Harper Collins Books of Canada Ltd.

Logical Reasoning in Science and Technology (LoRST), 1991 — **Chemistry 20**

Format	Print Text ISBN 0471795321 Teacher Guide 047179533X
Annotation	This text takes a science–technology–society approach to the study of general science. It integrates the study of science with current technology, and the applications and implications for society as a whole, that encourages combining scientific knowledge and critical thinking to make individual decisions.
Price	$27.72 Text $48.83 Teacher Guide
Author	Glen Aikenhead
Distributor	John Wiley & Sons Canada Ltd.

Meeting Future Energy Needs: Teachers' Guide — **Chemistry 20–30**

Format	Print
Annotation	Describes a game simulating the use of energy resources. Players assume different roles: an energy review board, option/interest groups and interveners. They then examine a range of options to determine the best uses for future energy resources.
Price	Free
Distributor	P. J. Spratt & Associates Inc.

Merrill Chemistry: A Modern Course, 1990 **Chemistry 20–30**

Format	Print	
	Text	ISBN 0675064244
	Merrill Solving Problems in Chemistry	0675064120
	Laboratory Chemistry	0675064074
	Teacher Resource Book	0675064058
	Evaluation Program	067506404X
Annotation	This text and ancillary resources are organized around a central theme: the properties of matter are a consequence of its structure.	
Price	Contact distributor	
Author	Robert C. Smoot et al.	
Distributor	Bell & Howell Canada Ltd.	

Modern Approach to Comprehensive Chemistry (A), 1987 **Chemistry 20–30**

Format	Print	ISBN 0859506657
Annotation	Covers some of the major topics in Chemistry 20–30 in detail, and with illustrations.	
Price	Contact distributor	
Author	G. N. Gilmore	
Distributor	Copp Clark Pitman Ltd.	

Occupational Health and Safety Publications List and Order Form **Chemistry 20**

Format	Print
Annotation	Lists several publications available from the Alberta Labour Library.
Price	Free
Distributor	Alberta Labour Library

Power and the Promise (The), 1993 **Chemistry 20–30**

Format	Print	ISBN 0969715404
Annotation	This resource includes the medical research and personal profiles of some of Alberta's scientists who are on the leading edge of research in the genetics of cancer, infectious diseases, nerve regeneration and other areas. It reports on current medical research in the province, combined with information on patient and population health research.	
Price	Free	
Author	Alberta Heritage Foundation for Medical Research	
Distributor	Alberta Heritage Foundation for Medical Research	

Problem Solving in General Chemistry, Fourth Edition, 1992 **Chemistry 30**

Format	Print	ISBN 0030751640
Annotation	This publication contains 21 chapters corresponding to the first 21 chapters in the texts *General Chemistry* and *General Chemistry with Qualitative Analysis*. Each chapter consists of: 1. a brief discussion of topics 2. examples to illustrate the topics 3. exercises coded by topic 4. miscellaneous exercises 5. answers to all the exercises.	
Price	$24.95	
Author	Kenneth W. Whitten, Kenneth D. Gailey and Raymond E. Davis	
Distributor	Harcourt Brace and Company Canada	

Problems in Chemistry, 1990 **Chemistry 20–30**

Format	Print	ISBN 0074526650
Annotation	Each chapter contains a summary of key concepts and several questions related to the concepts; for example, problems and solutions in acid-base chemistry and chemical equilibrium are addressed Complete answers are given for some questions, while others have answers only.	
Price	Contact distributor	
Author	Roland Smith	
Distributor	McGraw-Hill Ryerson Ltd.	

Science Matters: Achieving Scientific Literacy, 1991 **Chemistry 20**

Format: Print ISBN 038526108X

Annotation: This book provides the information toward becoming scientifically literate. It contains chapters on:

- Scientific Literacy
- Knowing Energy
- Electricity and Magnetism
- The Atom
- The World of the Quantum
- Chemical Bonding
- Atomic Architecture
- Nuclear Physics
- Particle Physics
- Astronomy
- The Cosmos
- Relativity
- The Restless Earth
- Earth Cycles
- The Ladder of Life
- The Code of Life
- Evolution
- Ecosystems.

Price: Contact distributor

Author: Robert M. Hazen and James Trefil

Distributor: Doubleday Canada Ltd.

Senior High Science Inservice Modules, 1991 **Chemistry 20–30**

Format: Print

Annotation: A system-based development model for workshops, a planning manual, containing the following thirteen modules:

Module 1 – Teaching for Thinking
Module 2 – STS Teaching Strategies
Module 3 – Controversial Issues in the Classroom
Module 4 – Focus on Research
Module 5 – Science 10: A Hands-on Sampler
Module 6 – Performance Assessment in Science 10
Module 7 – Technology and Media in the Science Classroom
Module 8 – Cooperative Learning
Module 9 – Teaching for Conceptual Change
Module 10 – Teaching with Gender Balance
Module 11 – Questioning Techniques for Science Teachers
Module 12 – Environmental Connections in the New Science Programs
Module 13 – Agricultural Connections in the New Science Programs

Price: $25 (not available individually)

Author: Alberta Education

Distributor: LRDC 144684

State of Canada's Environment (The), 1991 **Chemistry 20–30**

Format	Print	ISBN 0660142376
Annotation	This report covers environmental concerns and what Canadians are doing to address them. What are the key environmental conditions and trends in Canada? What are the links between human activities and environmental changes? What are the ecological and health dangers?	
Price	$29.95	
Author	Environment Canada	
Distributor	Environment Canada	

Structured Questions for GCSE Chemistry, 1988 **Chemistry 20**

Format	Print	ISBN 0340371552
Annotation	This book, for the General Certificate for Secondary Education (Britain), has science–technology–society questions in chemistry that can be used for tests or discussions.	
Price	Contact distributor	
Author	J. R. L. Swain and J. S. Clarke	
Distributor	Pippin Publishing Ltd.	

STS Science Education: Unifying the Goals of Science, 1990 **Chemistry 20–30**

Format	Print	
Annotation	This publication provides a comprehensive description to help integrate the science–technology–society concepts into teaching schemes.	
Price	$3.25	
Author	F. Jenkins	
Distributor	LRDC	162769

Teaching Thinking: Enhancing Learning, 1990 **Chemistry 20–30**

Format	Print	ISBN 1550062271
Annotation	Principles and guidelines for cultivating thinking, from Early Childhood Services to Grade 12, have been developed in this resource. It offers a definition of thinking, describes nine basic principles upon which the suggested practices are based, and discusses possible procedures for implementation in schools and classrooms.	
Price	$4.20	
Author	Alberta Education	
Distributor	LRDC	161521

Together We Learn (Co-operative Small Group Learning), 1990 **Chemistry 20–30**

Format	Print/Video		
Annotation	This "how to" handbook is designed to help implement small group learning strategies in the classroom. It offers the following: • a nuts and bolts approach to cooperative learning that provides classroom suggestions and aids • thorough coverage of cooperative learning approaches to assist teachers of varying levels of experience with group work • suggestions that are relevant to all grades, disciplines and students • a jargon-free, easy to read, treatment of cooperative learning techniques.		
Price	Contact distributor		
Author	R. Wideman et al.		
Distributor	LRDC ACCESS Network	Print Video	148959

Triumph of Discovery (The): Women Scientists Who Won the Nobel Prize, 1991 — **Chemistry 20–30**

Format	Print Hardcover ISBN 0671693328 Softcover 0671693336
Annotation	The Nobel Prize laureate is one of the most sought after of the international honours. Nearly 500 Nobel prizes have been awarded to scientists, ten of whom were women. This book tells the story of four of these female scientists from their early struggles to their breakthrough discoveries. Maria Goeppert – fought prejudice toward women in science to study physics in her native Germany. Her work helped lead to the development of the atomic bomb and experimentation with shell models. Rosalyn Yalow – a scientist, wife and mother, whose study of nuclear physics led her to discover ways of "tagging" substances in blood with radioactive tracers. Barbara McClintock – overcame the opposition of her family to attend college and devote her life to the study of maize genetics. Rita Levi-Montalcini – survived anti-Semitism in facist Italy to train as a doctor and biologist investigating nerve growth.
Price	$13.98 U.S. Hardcover $8.95 U.S. Softcover
Author	Joan Dash
Distributor	Julian Messner

World of Chemistry, 1991 — **Chemistry 20**

Format	Print ISBN 003030167X Instructor's Manual 0030301734 and Test Bank
Annotation	The text uses a science–technology–society approach to the study of chemistry. The instructor's manual includes answers to the questions at the end of each chapter and a testbank of multiple choice questions for each chapter.
Price	Contact distributor
Author	Melvin D. Joesten et al.
Distributor	Harcourt Brace and Company Canada

Other Learning Resources: Chemistry 20

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Note: Prices of resources are listed as provided by distributors, May 1993. Check with distributor for current rates.

Unit 1: Matter as Solutions, Acids, Bases and Gases

Chemical Bonds: The World of Chemistry Series, 1990

Format	Video (15 minutes)
Annotation	This program discusses ionic and covalent bonding.
Price	$55 (or $450 for series)
Distributor	Magic Lantern Communications Ltd.

Chemical Survey & Solutions and Pollution, 1990

Format	Print ISBN 0201284200
Annotation	A series of activity-based instruction modules integrating chemical and Earth sciences concepts and processes with societal issues. An inquiry-based, problem-solving approach to learning. Emphasizes evidence-based decision making. The program discusses how chemicals are defined and manufactured, and introduces survey research, data analysis techniques and societal issues. An accompanying kit, which includes a teacher manual plus all the equipment and supplies needed to conduct the activities, is available at an additional cost.
Price	$25.12
Author	Chemical Education for Public Understanding Program (CEPUP)
Distributor	Addison-Wesley Publishers Limited

Chemistry Counts: Practical Investigations, 1989

Format	Print	ISBN 0340506598
Annotation	Offers 96 varied and original photocopiable investigations for chemistry. Investigations: • are usually set in an industrial, technological or commercial context • have clear instructions for planning, designing or carrying out experiments and explorations • include questions to emphasize relevance and develop key concepts • are accompanied by full equipment lists.	
Price	Contact distributor	
Author	Graham Hill and Susan Walker	
Distributor	Pippin Publishing Ltd.	

Chemistry of the Earth: The World of Chemistry Series, 1988

Format	Video (15 minutes)
Annotation	The principles of solubility, precipitation, equilibrium and acid–base chemistry are applied in explaining mineral deposits and distribution of ores. Silicate minerals are used to illustrate the relationship between chemical structure and macroscopic properties. The history and formation of stalactites and stalagmites is explained.
Price	$55 ($450 for series)
Distributor	Magic Lantern Communications Ltd.

Materials: Pathways Through Science Series, 1992

Format	Print	ISBN 0582094046
Annotation	This module contains strategies and activities dealing with the physical and chemical properties of various substances. Examples of some of the investigations are how chemicals are made and used in industry and the home. A commentary is cross-referenced to the activities and provides background information and sample results of experiments. A source book contains science–technology–society connections related to the properties and uses of certain materials. A study guide outlines main ideas for review. Some of the examples used have a British context.	
Price	$69.56	
Distributor	Copp Clark Pitman Ltd.	

Pesticide Education Program, 1991

Format: Kit (5 parts)

Annotation: This resource consists of the following:

1. Forest Tent Caterpillar Study
2. Mosquito Kit
3. Vegetative Management Study
4. Pesticide Education Unit
5. Weed Kit.

Price: Free

Distributor: Alberta Environmental Protection

Proton in Chemistry (The): The World of Chemistry Series, 1990

Format: Video (28 minutes)

Annotation: This film focuses on acids, bases and pH; how they function in the laboratory and in natural systems.

Price: $99

Distributor: Magic Lantern Communications Ltd.

What's on Tap? The Global Environment Series, 1991

Format: Video (20 minutes)

Annotation: There is increasing trouble with the world's water supply. In Third World countries, children die each day from diarrhea often caused by water-borne parasites and bacteria. Even in industrialized countries, water purification requires careful monitoring. Certain chemicals in the water can cause disease in animals and people. Natural reservoirs are being tapped, and possibly tapped out, as the need of fresh water increases.

Price: $99

Distributor: Coronet Film and Video

Unit 2: Quantitative Relationships in Chemical Changes

Catalysts: Science Topics, 1985

Format	Video (20 minutes)
Annotation	The program looks at the exhaust emissions in Los Angeles, where, to reduce the levels of toxic gases, most vehicles are fitted with "catalytic convertors". Computer graphics show how molecular collisions are relatively infrequent in the gas phase. However, on the surface of a solid catalyst, molecules come together in quite high concentrations. Many large-scale industrial processes are economically possible only because of the widespread use of catalysts, which reduce the severity of reaction conditions and therefore the energy required. Enzymes are nature's catalysts, which are specific to just one reaction, and in many respects more advanced than conventional catalysts.
Price	$349
Distributor	BBC Enterprises

Catalysts and Catalytic Reactions: Chemistry: From Theory to Application Series, 1989

Format	Video (13 minutes)
Annotation	A series of experiments demonstrates some chemical reactions in which the addition of a catalyst can speed up the reaction. Catalysts are unaffected by the reaction and can be used again. Catalysts in petroleum refining and ammonia production are important to modern technology.
Price	$250
Distributor	Marlin Motion Pictures Ltd.

Investigating Chemical Processes: Your Island Factory, 1992

Format	Print	ISBN 0201284324
Annotation	A series of activity-based instruction modules integrating chemical and Earth sciences concepts and processes with societal issues. An inquiry-based problem-solving approach to learning. Emphasizes evidence-based decision making. Attitudes and perceptions of four representative industries; computers, food processing, chemical manufacturing and oil refining, are examined as a basis for discussion of the influence of a business in a community. Included is a teacher's manual, plus all the equipment and supplies needed to conduct the activities.	
Price	$23.24	
Author	Chemical Education for Public Understanding Program (CEPUP)	
Distributor	Addison-Wesley Publishers Limited	

Mole (The): The World of Chemistry Series, 1989

Format	Video (28 minutes)
Annotation	The concept of the mole is used to explain quantitative chemical change, using examples from small laboratory settings to large-scale industrial processes.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Mole (The): The World of Chemistry Series, 1990

Format	Video (15 minutes) (high school version)
Annotation	Avogadro's law, the mole as a unit for counting particles, the size of Avogadro's number, relative atomic mass, the importance of using the mole in chemical reactions and an example of limiting reactions, are illustrated, using graphics demonstrations and real-world examples.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Unit 3: Chemical Bonding in Matter

Bonding, Part 2 (Dipole–Dipole, Hydrogen, van der Waals and Metallic Bonding), 1992

Format: Video (18 minutes)

Annotation: The program describes relative bond strengths, examples of dipole–dipole attraction, polar covalent bonds, hydrogen bonds in water, and van der Waals forces in methane, nitrogen and oxygen. Examples of metallic bonding in gold and silver help to explain this concept and why metals are good conductors, ductile and malleable.

Price: $69

Distributor: Classroom Video

Chemical Bonds: The World of Chemistry Series, 1990

Format: Video (30 minutes)

Annotation: The program explores the nature of chemical bonds that hold all molecules together through diverse examples of mineral crystals, explosives and fertilizers.

Price: $99

Distributor: Magic Lantern Communication Ltd.

Electron Arrangement: Electron Arrangement and Bonding Series, 1984

Format: Video (10 minutes)

Annotation: When physicists Erwin Schrödinger and Werner Heisenberg applied wave mechanics to the atom, they theorized that Bohr's energy levels consisted of sublevels or orbitals. This program demonstrates the importance of the number of electrons in the outer orbitals to the properties of the atom by reviewing Bohr's energy levels in terms of the Schrödinger/Heisenberg application of wave mechanics to the atom.

Price: Contact distributor

Distributor: ACCESS Network VC289303

How Atoms Bond: Electron Arrangement and Bonding Series, 1984

Format	Video (10 minutes)
Annotation	The forces of attraction and repulsion within atoms are examined, as well as the different types of bonds that form. The formation of covalent and ionic bonds are shown.
Price	Contact distributor
Distributor	ACCESS Network VC289304

Ionic and Covalent Bonding, 1992

Format	Video (27 minutes)
Annotation	The first of two programs on bonding: the scientific categories used by chemists to classify substances; the role of electronegativity in determining whether a bond is pure covalent, or ionic; the conductivity of salts as molten liquid and in water solution—all salts in dilute aqueous solution completely dissociate; covalent network, molecular solids like graphite, diamond and silicone dioxide; the shapes of simple covalent molecules and the properties of short- and long-chain, covalently bonded compounds.
Price	$69
Distributor	Classroom Video

Metals and Ionic Solids: Electron Arrangement and Bonding Series, 1984

Format	Video (10 minutes)
Annotation	The common properties of metals, such as conductivity and malleability, can be attributed to the types of bonding that exist between metal atoms. The properties of metallic covalent solids are compared with those of crystalline ionic solids.
Price	Contact distributor
Distributor	ACCESS Network VC289306

Molecular Bonding: A Union of Atoms: Chemistry: From Theory to Application Series, 1989

Format: Video (13 minutes)

Annotation: Mercury and chlorine can both be solidified at low temperatures. Experiments show that the nucleus and the surrounding electrons of mercury and chlorine are distributed differently. These characteristics account for the differences in electrical conductivity.

Price: $190

Distributor: Marlin Motion Pictures Ltd.

Molecular Substance and Covalent Crystals: Electron Arrangement and Bonding Series, 1984

Format: Video (10 minutes)

Annotation: Defines and illustrates the dynamics of stable and unstable atomic bonds. Diatomic molecules form when atoms share pairs of electrons, held together by covalent bonds. Polar molecules, produced by a combination of covalent and ionic bonds, occur when one nucleus has a stronger charge than the other.

Price: Contact distributor

Distributor: ACCESS Network VC289305

Silicon, 1992

Format: Video (13 minutes)

Annotation: Covers where silicon is found, how it is chemically recovered, and its many uses in modern society. The purification process, and the application of silicon in semiconductors and microelectric industries, is shown. Silicon, a metalloid, is an inorganic chemical element whose physical properties resemble those of both metals and nonmetals. It does not occur in nature in a free state, but is found in combination with oxygen, in the form of silicon dioxide, or oxygen and other elements, such as calcium and aluminum—as silicates. The second most abundant element in the Earth's crust, silicon may be found in almost all rocks, as well as sand, clay and soil.

Price: $500

Distributor: Marlin Motion Pictures Ltd.

Unit 4: The Diversity of Matter: An Introduction to Organic Chemistry

Age of Polymers (The): The World of Chemistry Series, 1988

Format	Video (15 minutes)
Annotation	This film is a demonstration of nylon making. There are graphical representations of fractional distillation, catalytic cracking and making polyethylene. Styrene and polystyrene are described. There is also a feature on recycling.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Carbon: Chemistry: From Theory to Application Series, 1990

Format	Video (13 minutes)
Annotation	Carbon is a part of the structure of all life and much of inanimate nature. Examples of the carbon compounds examined are graphite and diamond.
Price	$500
Distributor	Marlin Motion Pictures Ltd.

Carbon: The World of Chemistry Series, 1989

Format	Video (30 minutes)
Annotation	The program introduces the field of organic chemistry by examining how carbon-based molecules, such as aspirin, are made.
Price	$250
Distributor	Magic Lantern Communications Ltd.

Carbon Chemistry, 1992

Format	Video (41 minutes)
Annotation	The program introduces the structure, function and diversity of the carbon atom, starting with simple compounds and moving in logical sequence through to complex branched chains. Part 1: Carbon Chemistry (28 minutes): hydrocarbons, alkenes and alkynes, haloalkanes, saturation tests. Part 2: Laboratory Demonstrations (13 minutes): esterification, saponification, distillation.
Price	$69
Distributor	Classroom Video

Chemistry of Soap, 1991

Format	Video (13 minutes)
Annotation	The chemical properties of soap are explained in terms of the basic cleaning agent, the surfactant, which works to remove dirt. Live action and animated graphics examine the nature and uses of several types of surfactants, both natural and synthetic. A discussion of the chemistry of soap begins with the way surfactants work. Experiments demonstrate how they affect the surface tension of water, allowing it to bond with, moisten and dissolve grease and dirt. The chemical properties of various types of synthetic surfactants are examined. The biodegradability of detergents are examined in terms of their environmental impact.
Price	$49.95
Distributor	Canadian Learning Company

Colour: The World of Chemistry Series, 1989

Format	Video (15 minutes) (high school version)
Annotation	The role of colour and dyes is traced in the development of modern chemistry and how they, in turn, help chemists study the molecular world.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Environmental Choice Factsheets

Format	Factsheets
Annotation	1. Newsprint from Recycled Paper 2. Re-refined Motor Oil 3. Fine Paper from Recycled Paper
Price	Free
Distributor	Environmental Choice Program

Fibres: Organic Chemistry II Series, 1987

Format	Video (10 minutes)
Annotation	The program traces the historical development of natural and synthetic fibres and explains how the molecular structure of fibres is modified to suit the varied demands of today's consumer. The main focus is on the role of carbon in the manufacture of nylon and rayon.
Price	Contact distributor
Distributor	TV Ontario

Making Materials: Pathways Through Science Series, 1993

Format	Print ISBN 0582094100
Annotation	This module contains strategies and activities dealing with the testing and making of materials. Examples of some of the investigations are planning, record keeping and revision of materials. A commentary is cross-referenced to the activities and provides background information and sample results of experiments. A source book contains science–technology–society connections related to plastics and various hydrocarbons. A study guide outlines main ideas for review. Some of the examples used have a British context.
Price	$69.56
Distributor	Copp Clark Pitman Ltd.

Methane: The Simplest Hydrocarbon, 1992

Format	Video (14 minutes)
Annotation	The program focuses on the main ingredient in natural gas—methane—perhaps the cleanest and cheapest of all the fuels that cook our food and warm our homes.
Price	$750
Distributor	Marlin Motion Pictures Ltd.

Petroleum: River of Energy, 1989

Format	Video (60 minutes)
Annotation	Provides a comprehensive overview of the petroleum industry, including an historical perspective, exploration drilling, production and product. Future challenges facing the industry are also examined. It was distributed to all junior high schools in Alberta.
Price	Contact distributor
Distributor	ACCESS Network VC284301

Plastics, 1992

Format	Video (16 minutes)
Annotation	This advanced program illustrates the chemistry of plastics and demonstrates the practical advantages that these human-made materials have over naturally occurring materials that might be used. Plastics are produced by the process of polymerization of low-boiling crude oil distillates. Chemists have learned to manipulate the manufacturing processes to produce a variety of polymer structures with varying physical properties. The widespread use of plastics has created the problem of how to deal with plastic waste. The program explores possible solutions ranging from recycling to the use of plastics in nondisposable applications.
Price	$750
Distributor	Marlin Motion Pictures Ltd.

Plastics in Our Lives, 1992

Format	Print ISBN 0201284308
Annotation	A series of activity-based instruction modules integrating chemical and Earth sciences concepts and processes with societal issues. An inquiry-based problem-solving approach to learning. Emphasizes evidence-based decision making. Viewers are asked to decide whether or not their town should use exclusively plastic bags or paper bags. Thus, they become aware of the physical properties of common plastics, as well as the advantages and disadvantages of each type of bag. Various methods of recycling are presented. The kit includes a teacher's manual plus all the equipment and supplies that are needed to conduct the activities.
Price	$23.24
Author	Chemical Education for Public Understanding Program (CEPUP)
Distributor	Addison-Wesley Publishers Limited

Polyethylene: Chemistry in Action Series, 1985

Format	Video (20 minutes)
Annotation	This program demonstrates the polymerization of ethylene at different pressures and in the presence of different catalysts, depending on the intended end use of the polyethylene. It also shows the molding of polyethylene into commercial products, and the testing and analytical techniques used to determine their properties. Some of the advantages and disadvantages of replacing wood and glass with plastic products are discussed.
Price	$149 U.S.
Distributor	Films for the Humanities and Sciences

Proteins: Structure and Function: The World of Chemistry Series, 1990

Format	Video (28 minutes)
Annotation	This video unravels the mysteries of proteins in terms of their structure and function.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Other Learning Resources: Chemistry 30

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Note: Prices of resources are listed as provided by distributors, May 1993. Check with distributor for current rates.

Unit 1: Thermochemical Changes

Fossil Fuels, 1991

Format	Video (19 minutes)
Annotation	This videotape explains the origin, uses, and environmental impacts of coal, oil and natural gas. Interviews and graphics are used to show how Earth's nonrenewable energy resources are formed. Computer maps and graphs locate these resources. Geologically, the processes that create fossil fuels take millions of years in a natural process known as the carbon cycle. Today, fossil fuels have become the world's most widely used energy resource. Experts wonder how long this can last. To meet this challenge, ways must be found to conserve existing fossil fuels while advancing alternative energy sources. Renewable energies, such as solar power, may hold the promise of the future—long after the age of fossil fuels has past.
Price	$64.95 U.S.
Distributor	Scott Resources Inc.

Nuclear Power: Fission, Fusion and Their Applications, 1992

Format	Video (31 minutes)
Annotation	This program looks at the practical applications of nuclear energy and includes footage from nuclear power stations and fusion laboratories.
Price	$69
Distributor	Classroom Video

Unit 2: Electrochemical Changes

Busy Electron (The): The World of Chemistry Series, 1990

Format: Video (28 minutes)

Annotation: Illustrates reactions involving electron transfer, using the examples of the electrochemical cell, corrosion and electrolysis.

Price: $99

Distributor: Magic Lantern Communications Ltd.

Ions and Electrons in Metals: Chemistry: From Theory to Application, 1989

Format: Video (12 minutes)

Annotation: In one electric circuit, electrons flow continuously in a copper wire. In the second circuit, copper forms only a part of the conductive path; the rest is an electrolytic solution and a platinum electrode. The migration of the copper ions and the removal and addition of electrons is demonstrated.

Price: $250

Distributor: Marlin Motion Pictures Ltd.

Oxidation-Reduction: The World of Chemistry Series, 1990

Format: Video (15 minutes)

Annotation: Oxidation-reduction—redox—reactions are presented. Various common examples involving metals are related in two laboratory experiments. Other specific reactions used for the electrical energy they generate are the zinc copper cell, the lithium battery and the lead storage battery.

Price: $99

Distributor: Magic Lantern Communications Ltd.

Unit 3: Equilibrium, Acids and Bases in Chemical Changes

Chemical Equilibrium, 1988

Format: Video (24 minutes)

Annotation: This program looks at chemical equilibria and the environment. The Earth's biosphere is a dynamic system fuelled by the Sun. The program illustrates chemical concepts with analogies. Content includes:

- the effect of temperature on chemical reactions
- how molecules behave at equilibrium
- equilibrium in phase changes and solutions
- altering equilibrium states and predicting changes
- limestone caves
- carbon, carbon dioxide and systems far from equilibrium.

Price: $69

Distributor: Classroom Video

Equilibrium: Chemistry: From Theory to Application Series, 1989

Format: Video (12 minutes)

Annotation: Chemical reactions involve molecules that are either decomposed or synthesized. Under certain conditions, the forward and the reverse reactions proceed at an equal pace. This is referred to as chemical equilibrium.

Price: $190

Distributor: Marlin Motion Pictures Ltd.

Molecules in Action: The World of Chemistry Series, 1990

Format: Video (28 minutes)

Annotation: The program examines molecules during chemical reactions and the role that catalysts play in chemical transformation.

Price: $99

Distributor: Magic Lantern Communications Ltd.

DISTRIBUTOR ADDRESSES

DISTRIBUTOR ADDRESSES

- ACCESS Network
  Media Resource Centre
  3720 – 76 Avenue
  Edmonton, Alberta
  T6B 2N9
  Telephone: 440–7777 (Edmonton)
  1–800–352–8293 (rest of province)
  Fax: (403) 440–8899

- Addison-Wesley Publishers Limited
  26 Prince Andrew Place
  P.O. Box 580
  Don Mills, Ontario
  M3C 2T8
  Telephone: (416) 447–5101
  Fax: (416) 443–0948

- Agriculture Canada
  Room E107
  Sir John Carling Building
  930 Carling Avenue
  Ottawa, Ontario
  K1A 0C7
  Telephone: (613) 995–8963
  Fax: (613) 996–5911

- Alberta Agriculture, Food and Rural Development
  Communications Division, Publications
  7000 – 113 Street
  Edmonton, Alberta
  T6H 5T6
  Telephone: (403) 427–0391
  Fax: (403) 427–2861

- Alberta Energy
  Energy Efficiency Branch
  Education Services
  7th Floor, 9945 – 108 Street
  Edmonton, Alberta
  T5K 2G6
  Telephone: (403) 427–5200
  Fax: (403) 422–0494

- Alberta Environmental Protection, Education Branch
  12th Floor, Oxbridge Place
  9820 – 106 Street
  Edmonton, Alberta
  T5K 2J6
  Telephone: (403) 427–6310
  Fax: (403) 427–1178

- Alberta Heritage Foundation for Medical Research
  3125 Manulife Place
  10180 – 101 Street
  Edmonton, Alberta
  T5J 3S4
  Telephone: (403) 423–5727
  Fax: (403) 429–3509

- Alberta Labour Library
  3rd Floor, 10808 – 99 Avenue
  Edmonton, Alberta
  T5K 0G5
  Telephone: (403) 427–8533
  Fax: (403) 422–5070

- Alberta Special Waste Management Corporation
  Suite 610, 10909 Jasper Avenue
  Edmonton, Alberta
  T5J 3L9
  Toll Free: 1–800–272–8873
  Telephone: (403) 422–5029
  Fax: (403) 428–9627

- AMSCO School Publications
  315 Hudson Street
  New York, NY 10013
  U.S.A.
  Telephone: (212) 675–7000
  Fax: (212) 675–7010

- BBC Enterprises
  65 Heward Avenue
  Suite 111
  Toronto, Ontario
  M4M 2T5
  Telephone: (416) 469–1505
  Fax: (416) 469–0692

- Bell & Howell Canada Ltd.
  230 Barmac Drive
  Weston, Ontario
  M9L 2X5
  Telephone: (416) 747–4638
  Fax: (416) 746–0026

- Boreal Laboratories Ltd.
  399 Vanickle Road
  St. Catherins, Ontario
  L2S 3T4
  Telephone: (416) 984–3000
  Fax: (416) 984–3311

- Britannica Learning Materials
  P.O. Box 2249
  175 Holiday Inn Drive
  Cambridge, Ontario
  N3C 3N4
  Telephone: (519) 658–4621
  Fax: (519) 658–8181

- Bullfrog Films, Inc.
  Oley, Pennsylvania 19547
  U.S.A.
  Telephone: (215) 779–8226
  Fax: (215) 370–1978
  OR Canadian Distributor
  NcNabb and Connolly Films

- Cambridge University Press
  Edinburgh Building
  Cambridge, Great Britian
  CB2 2RP
  Telephone: (0223) 31–2393

  40 West 20th Street
  New York, NY 10011
  U.S.A.
  Toll Free: 1–800–221–4512
  Telephone: (212) 924–3900

- Canadian Association of Petroleum Producers
  Safety, Health and Environment
  2100, 350–7 Avenue SW
  Calgary, Alberta
  T2P 3N9
  Telephone: (403) 267–1100
  Fax: (403) 261–4622

- Canadian Climate Centre
  Climate Services Division
  4905 Dufferin Street
  Downsview, Ontario
  M3H 5T4
  Telephone: (416) 739–4324

- Canadian Government Publishing Centre
  Supply and Services
  Ottawa, Ontario
  K1A 0S9
  Telephone: (819) 997–6363
  Fax: (819) 994–4296

- Canadian Learning Company
  63 Mack Avenue
  Scarborough, Ontario
  M1L 1M5
  Telephone: (416) 691–9094
  Fax: (416) 691–8833

- Canadian Red Cross Society
  Alberta–Northwest Territories Division
  737 – 13 Avenue SW
  Calgary, Alberta
  T2R 1J1
  Telephone: (403) 228–2169
  Fax: (403) 541–4444

- CBC Educational Sales
  Box 500
  Station A
  Toronto, Ontario
  M5W 1E6
  Telephone: (416) 205–6384
  Fax: (416) 205–3482

- Center for Applied Research in Education (The)
  200 Old Tapen Road
  Old Tapen, New Jersey 07675
  U.S.A.
  Toll Free: 1–800–223–1360
  Fax: 1–800–445–6991

- Classroom Video
  9005 Centaurius Circle
  Unit C
  Burnaby, British Columbia
  V3J 7N4
  Telephone: (604) 420–3066
  Fax: (604) 420–3095

- Copp Clark Pitman Ltd.
  2775 Matheson Blvd. East
  Mississauga, Ontario
  L4W 4P7
  Telephone: (416) 238–6074
  Fax: (416) 238–6075

- Coronet Film and Video
  3771 Victoria Park Avenue
  Scarborough, Ontario
  M1W 2P9
  Toll Free: 1–800–263–4005
  Fax: (416) 497–3637

- CRC Press
  2000 Corporate Blvd. NW
  Boca Raton, Florida 33431
  U.S.A.
  Fax: (407) 997–0949

- CTV Program Sales
  42 Charles Street East
  Toronto, Ontario
  M4Y 1T5
  Telephone: (416) 928–6095
  Fax: (416) 928–0907

- C. V. Mosby Co. Ltd.
  5240 Finch Avenue East, Unit 1
  Scarborough, Ontario
  M1S 4P2
  Telephone: (416) 298–1588
  Fax: (416) 298–8071

- D. C. Heath Canada Ltd.
  Suite 1600
  100 Adelaide Street W
  Toronto, Ontario
  M5H 1S9
  Telephone: (416) 362–6483
  Fax: (416) 362–7942

- Doubleday Canada Ltd.
  105 Bond Street
  Toronto, Ontario
  M5B 1Y3
  Telephone: (416) 340–0777
  Fax: (416) 340–9957

- Ducks Unlimited Canada
  202, 10470 – 176 Street
  Edmonton, Alberta
  T5S 1L3
  Telephone: (403) 489–2002
  Fax: (403) 489–1856

- The Education Group
  1235 Sunset Plaza Drive
  Los Angeles, California 90069
  U.S.A.
  Telephone: (310) 659–8842
  Fax: (310) 855–8061

- Education Through Video Ltd.
  7 Wellwood Avenue
  Toronto, Ontario
  M6C 1G8
  Telephone: (416) 656–6953
  Fax: (416) 449–5424

- EME Incorporated
  41 Kenosia Avenue
  P.O. Box 2805
  Danbury, Connecticut 06813–2805
  U.S.A.
  Telephone: (203) 798–2050
  Fax: (203) 798–9930

- Environment Canada
  Communications Division
  Prairie and Northern Region
  Room 210, 4999 – 98 Avenue
  Edmonton, Alberta
  T6B 2X3
  Toll Free: 1–800–668–6767
  Fax: (819) 953–2225

- Environmental Choice Program
  107 Sparks Street, 2nd Floor
  Ottawa, Ontario
  K1P 5B5
  Fax: (613) 952–9465

- Environmental Council of Alberta
  Suite 400
  9925 – 109 Street
  Edmonton, Alberta
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